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Sources of Borrowing and Fiscal Multipliers*

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Abstract

We find that debt-financed government spending multipliers vary considerably depending on the location of the debt holder. In a sample of 59 countries we find that government spending multipliers are larger when government purchases are financed by issuing debt to foreign investors (non-residents), compared to the case when government purchases are financed by issuing debt to home investors (residents). In a theoretical model we show that the location of the government debt holder produces these differential responses through the extent that private investment is crowded out in each case. Increasing international capital mobility of the resident private sector decreases the difference between the two types of financing, a prediction, which is also confirmed by the data. The share of rule-of-thumb workers, as well as the strength of the public good in the utility function play a key role in generating model-based fiscal multipliers, which are quantitatively comparable with those of the data.

Keywords: Debt financing, fiscal multipliers, government spending, magnitude restrictions, small open economy, structural vector autoregressions

JEL: E2, F41, G15, H6

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1 Introduction

Since the onset of the European debt crisis in 2009 several European economies have embarked on measures to reduce their government spending in the view of improving their fiscal positions and returning to growth. During this ongoing process a number of the leading actors in the European crisis have prescribed policies, which have triggered a heated economic debate with regards to their prospects for economic recovery. Since 2013, the focus of attention has been the size of fiscal multipliers. This debate was revitalized at the same time when statistics of progress were published for countries like Greece, Italy and Spain, which had failed to recur to pre-crisis growth rates.

The question we attempt to answer in this paper is whether the transmission mechanism of a fiscal shock depends on the government's source of borrowing. Economic theory, but also our empirical investigation, suggest that a government spending shock can produce differential effects on the real economy if it is financed with debt issued to home investors (residents), or debt issued to foreign investors (non-residents). These differences extend to the size of fiscal multipliers, which in particular are larger when government spending is financed with debt placed abroad.

We approach the question in a twofold way. First, we construct a small open economy model with a government that finances its spending by borrowing domestically and abroad, and a domestic private sector, which faces financial frictions in borrowing abroad. We show that the key mechanism for obtaining differing fiscal multipliers fundamentally relies on the composition of the economy's resource constraint. If the private sector is restricted in its external borrowing then domestic government borrowing takes resources from the private sector that can no longer be invested. Instead, if the government borrows abroad, the government acquires resources from abroad so that domestic investment need not fall; to the contrary, we show that it may even rise, ultimately implying that the fiscal multiplier is larger when spending is financed with debt held abroad.

The severity of the private sector's financial friction is crucial in determining whether domestic government borrowing will displace investment. If foreign credit markets functioned perfectly then purchases of government debt could be fully financed by external

borrowing thus avoiding the displacement of investment following a spending shock. We show how the openness of foreign external markets matters for the magnitude of fiscal multipliers.

Armed with this intuition, we then study the responses of output, investment, and consumption to domestic and foreign debt-financed government spending shocks in a structural vector-autoregression (SVAR). Given the rarity of available data on the domestic and foreign components of aggregate public debt, we develop an innovative conceptual framework for identification.¹ We distinguish between a home debt-financed and a foreign debt-financed spending shock by extending the conventional sign restrictions approach of Canova and de Nìcolo (2003) to include magnitude restrictions in the spirit of Kilian and Murphy (2012). Our sign restrictions limit the responses of the endogenous variables in a way that is robust to a wide class of theoretical models, whilst we derive our magnitude restrictions by relying on a single assumption regarding the movements of the unobserved components of aggregate public debt and aggregate public external debt. In particular, following a home (foreign) debt-financed fiscal shock we require public debt to increase by more (less) than external debt. We show that this assumption is in line with the response of the current account in our theoretical model and in addition, is accepted by a large part of the empirical literature on fiscal policy. To further verify our proposed method of identification we estimate the same SVAR on US data, for which the disaggregated debt components of interest are available. We show that our methodology indeed extracts the relevant shocks in the US.

Our work ties in with several branches of the fiscal policy literature. On the empirical side, studies relying on the SVAR methodology consist of Blanchard and Perotti (1999); Fatas and Mihov (2001); Perotti (2005) among others. The conclusions generally suggest that private consumption, output, employment and the real wage increase with the fiscal shock, features which are all consistent with the results obtained in this paper. However, most of these studies do not allow for a flexible specification of how the spending shock is financed. This gap in the literature presumably arises because of the difficulty in obtaining

¹For example, data on public debt from the World Bank only reports 'central government debt' (Indicator code: GC.DOD.TOTL.GD.ZS) and 'external debt stocks' (Indicator code: DT.DOD.DECT.GN.ZS).

accurate data on the components of aggregate public debt. In this paper, we fill precisely this gap.

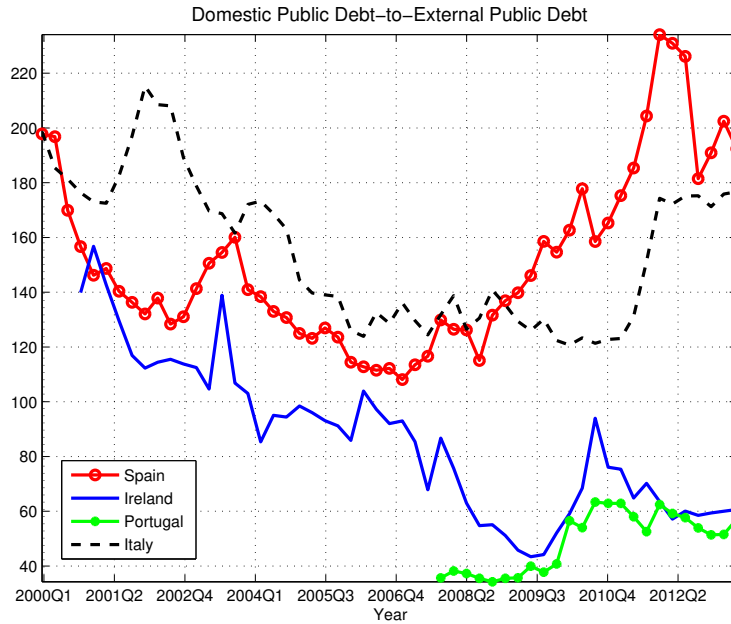
On the theoretical side, there is little work analyzing the effects of fiscal shocks to the real economy when the location of debt-financing is assessed. The closest study to ours is recent work by Shen and Yang (2012), who analyze the effects of government spending in a setting of limited capital mobility that is specific to developing countries. They show that in such an environment an externally-financed fiscal shock can reduce the crowding out of investment, but also generates a real appreciation of the exchange rate, which offsets the expansionary effects on output.

Our results can also be interpreted as an extension and empirical validation of Broner et al. (2014). Similar to this paper, they discuss how the purchases of government debt made by domestic creditors can cause investment to be crowded out unless financial markets are perfectly functional. Their focus however, is on the government's borrowing policy, which is determined by introducing creditor discrimination on the basis that domestic debt is harder to be defaulted on, thus offering a large expected return to domestic creditors. Here, we extend their message by concentrating on the implications of the financing of spending for the size of the fiscal multiplier. As we show, the response of investment following a spending shock is key in affecting the multiplier.

On the policy front our analysis has implications for the effects of fiscal consolidations in several European countries. Since foreign debt-financed spending shocks have higher multipliers this suggests that in countries such as Greece, where most of the debt is externally held, government expenditure cuts can cause deeper than anticipated recessions. This is opposed to the case of Italy, where the majority of government debt is domestically held. Thus, the composition of public debt alone can play a role in determining the business cycle absent any additional debt issuance. As can be seen in Figure (1.1) this issue is mostly relevant for the Eurozone's debt-distressed economies where the composition of public debt shifted from largely being held domestically to being held externally between 2000-2008. Our work suggests that the reliance on external debt during this period would correspond to a fiscal multiplier that turns negative and hence would worsen the downturn

during the financial crisis.

Figure 1.1: The Composition of Public Debt in the Eurozone Periphery



Such a conclusion may have important consequences for the fiscal consolidation packages proposed by the European Commission (EC), the European Central Bank (ECB) and the International Monetary Fund (IMF) during the still-unfolding debt crisis in the Eurozone's periphery. Through a reduction in private sector risk premia the negative impact from the changes in the composition of public debt can be greatly reduced. This highlights the importance of interactions between monetary and fiscal policies in the Eurozone and lends support to measures such as the ECB's longer-term refinancing operations. Our results also have important consequences regarding the reversion to pre-crisis growth. Omitting considerations regarding the location of financing of government consumption may erroneously lead to poorly-prescribed policies that actually deepen the recession when advocating cuts in public expenditures.

The remainder of the paper is structured as follows: In Section (2) we describe the empirical strategy used to estimate the SVAR and present results of the estimation. In Section (3) we build a theoretical model and in Section (4) we use it to illustrate the mechanism by undertaking a quantitative analysis. In Section (5) we report model-based fiscal multipliers and show how are model compares to the data. In Section (6) we focus on

the issue of imperfect capital mobility for the private sector and investigate its importance in driving the model's results. Finally, in Section (7) we conclude.

2 Empirical Investigation

In this section we study the effects of a government spending shock and propose a strategy for identifying whether it is financed with debt held by residents (Home-financed government spending shock), or by nonresidents abroad (Foreign-financed government spending shock). Our empirical procedure consists of estimating an SVAR for 59 countries, for which data availability on the location of debt holdings is not readily available. To identify the location of debt financing we propose a novel conceptual framework, which relies on making a single conventional assumption derived from theory.

2.1 Theoretical Background on SVARs

A Structural Vector Autoregression model (SVAR) can be written as:

$$A_0 y_{n,t} = \alpha_n + A_1 y_{n,t-1} + A_2 y_{n,t-2} + \dots + A_P y_{n,t-P} + B \varepsilon_{n,t} \quad (2.1)$$

where $y_{n,t}$ is a $k \times 1$ vector of endogenous variables for a given year t and country n , α_n are fixed effects, and where the structural errors are assumed to be white noise $\mathcal{N}(0, I_k)$. It is assumed that the true model can be represented via a finite lag VAR with lag $p \in [1, 2, \dots, P]$. The model in (2.1) then implies the following structural moving average representation:

$$y_{n,t} = B(L) \varepsilon_{n,t}$$

where $B(L)$ is the impulse response function. However, the system in (2.1) cannot be directly estimated, so we need to transform it into a reduced form representation:

$$y_{n,t} = a_n^* + A_1^* y_{n,t-1} + A_2^* y_{n,t-1} + \dots + A_P^* y_{n,t-P} + v_{n,t} \quad (2.2)$$

where $v_{n,t} = A_0^{-1}B\varepsilon_{n,t}$ and $A_p^* = A_0^{-1}A_p$ for $p \in [1, 2, \dots, P]$. We then choose to estimate the reduced form model (2.2) using a first difference estimator which eliminates possible fixed effects and transforms the data into stationary series.²

In addition, (2.1) also implies the following structural moving average representation:

$$y_{n,t} = C(L)v_{n,t} \quad (2.3)$$

where $C(L)$ is the non-structural impulse response function and is related to the structural impulse responses as $C(L) = A_0^{-1}B(L)$. By defining $S = A_0^{-1}B$ and given the assumed distribution of errors $\sum_{\varepsilon} = I$, then the impact matrix must satisfy

$$\sum_v = SS' \quad (2.4)$$

where \sum_v is the variance-covariance matrix of the reduced form errors. However, the structural decomposition in (2.4) is not unique and the way this decomposition is chosen will affect the identification of the impact matrix in the model. For example, for some arbitrary orthogonalization, \tilde{S} (e.g. a Choleski decomposition), the alternative structural decomposition can be obtained by randomly choosing a matrix H with $HH' = I$ and post-multiplying H by \tilde{S} . It is then immediate that $\tilde{S}H(\tilde{S}H)' = \tilde{S}\tilde{S}'$ and therefore the condition in (2.4) is satisfied. Therefore, the entire set of permissible impact matrices is infinite and the impact matrix cannot be identified from the data. To obtain a unique structural decomposition, the econometrician needs to assume $k(k-1)/2$ restrictions. In the present paper, rather than imposing restrictions to obtain a unique identification we obtain the distribution of impulse response functions by retaining only those that satisfy prior constraints derived from economic theory.

²As explained in Anderson and Hsiao (1982) the first difference estimator is not consistent for T fixed. Instead they propose to instrument lagged dependent variables by their second lags Δy_{t-2} . We experimented with IV estimation, but the results were imprecise due to weak instruments, thus driving us to opt for an OLS estimation. We have also estimated the model assuming fixed effects in the differenced model - the results do not change quantitatively in this case.

2.2 Identification of Shocks

The identification methodology consist of two stages. In the first stage we separate the (location-free) debt-financed fiscal shock from other standard shocks following the sign restrictions methodology used in Pappa (2009). The second stage complements the sign restrictions with additional magnitude restrictions that allow to disentangle a fiscal shock into one that is financed with debt issued to residents, and one with debt issued to non-residents. The constraints that we use are consistent with the model we propose in Section (3).

Sign restrictions

Pappa (2009) shows that in both a prototypical flexible price real business cycle model and a sticky price New Keynesian model fiscal shocks lead to an increase in output and the primary deficit. More importantly, other standard shocks, such as technology, monetary and demand shocks lead to an increase in output, but a fall in the primary deficit. To identify the debt-financed fiscal shock we thus assume that it leads to an increase in government spending, output and public debt.³

Home vs. foreign debt-financed fiscal shocks

The main question of interest is whether the source of financing of government debt is able to differentially affect the endogenous variables in our model. Thus, we have to identify two fiscal shocks, one that is financed by issuing debt to residents (Home) and one that is financed by issuing debt to non-residents (Foreign). The identification of these two shocks is more challenging due to the lack of data on the composition of public debt. The available debt data, obtained from Reinhart and Rogoff (2011) only reports '*total gross central government debt*' and '*total gross external debt*'. However, we do not have their disaggregated components '*total home public debt*' and '*total external public debt*', which would be of direct relevance for our empirical investigation. For example, looking

³The assumption that government spending increases after a (positive) fiscal shock also separates a fiscal shock from a shock to the risk premium of external financing. A positive shock to the risk premium would lead to a decrease in output, an increase in the government deficit, but also a decrease in government spending.

at equation (2.5), if data on '*total home public debt*' were available then it would be straightforward to identify the two types of shocks of interest.

$$\frac{\text{Total public debt}}{\text{Total external debt}} = \frac{\text{Public home debt} + \text{Public external debt}}{\text{Public external debt} + \text{Private external debt}} \quad (2.5)$$

Since such variables are not available for the whole sample, we identify the two shocks of interest by restricting the magnitudes of the responses of the endogenous variables. The prior for the magnitudes is derived from our theoretical model, and at the same time justified by a relatively weak assumption on the response of external debt following the two shocks. Furthermore, we also validate our identifying assumptions by estimating the same SVAR on US data (see Section (2.5)), a sample for which these disaggregated components are available.⁴

Magnitude Restrictions

The assumption under which our magnitude restrictions are satisfied states that:

1. *A positive government spending shock leads to an increase in external debt, which is smaller than the increase in public debt.*

The assumption states that any increase in government spending due to debt issuance, be it held domestically or abroad, will lead to a current account deterioration. However, the current account will deteriorate less than the total increase in government spending due to import leakage. This effect is validated in numerous studies that investigate the effects of government spending shocks on the trade balance (see e.g. Beetsma et al. (2008) for the EU, or Monacelli and Perotti (2010) for the US, UK, Canada and Australia) and is also a mechanism present in the model proposed in Section (3).⁵

⁴It is important to clarify here that we abstract from issues such as the location of debt issuance, the currency denomination of debt, the jurisdiction of issuance, the maturity of the assets, and other features such as which is the issuing government agency. What we are solely interested in exploring is whether debt-financed government policy produces differential results on other macroeconomic aggregates depending on whether the holder of debt resides within or outside the economy.

⁵We note that Kim and Roubini (2008) and Corsetti and Muller (2006) find that a spending shock in the US leads to an increase in the trade balance. We conjecture that these contrasting results stem from the alternate specification and identification methods used in these studies.

We can now translate the assumption in the analogous magnitude restrictions that will enable us to differentiate between the two types of shocks of interest.

Restriction 1: Home-debt financed government spending shock

By the consideration of the fiscal shock as debt-financed the increase in government spending increases total public debt. By Assumption (1) it also increases total external debt, however by a magnitude smaller than the increase in total public debt. This is shown in equation (2.6).

$$\Psi_{n,t+h}(\text{public debt}) \geq \Psi_{n,t+h}(\text{external debt}) \quad (2.6)$$

where $\Psi_{n,t+h}(\text{public debt})$ and $\Psi_{n,t+h}(\text{external debt})$ are the impulse responses of the corresponding debt components to the identified shock. Restriction 1 states that the increase in public debt is at least as large as the increase in external debt.

Restriction 2: Foreign-debt financed government spending shock

By the consideration of the fiscal shock as debt-financed the increase in government spending increases public debt. Given the definition of the shock, the increase of public debt will be financed one-for-one with the increase in external debt. Assumption (1) guarantees that a foreign debt-financed fiscal shock generates an additional 'accelerator effect', whereby external debt further increases due to the deterioration of the current account it implies. As a result, external debt increases more than public debt, which leads to the second magnitude restriction in equation (2.7).

$$\Psi_{n,t+h}(\text{public debt}) < \Psi_{n,t+h}(\text{external debt}) \quad (2.7)$$

where again $\Psi_{n,t+h}(\text{public debt})$ and $\Psi_{n,t+h}(\text{external debt})$ are the impulse responses of the corresponding debt components to the identified shock. Restriction 2 states that the increase in public debt is strictly smaller than the increase in external debt.

Identification restrictions

The sign restrictions and magnitude restrictions that we use can be seen in Table (1).⁶

Table 1: Identification Restrictions

Shock	G	Y	C	I	Public Debt	External Debt
Home financed fiscal shock	+	+			+	+
Foreign financed fiscal shock	+	+			+	+

(a) Sign restrictions

Shock	Restriction
Home financed fiscal shock	$\Delta \text{ public debt} \geq \Delta \text{ external debt}$
Foreign financed fiscal shock	$\Delta \text{ public debt} < \Delta \text{ external debt}$

(b) Magnitude restrictions

Notes: We impose these restrictions to hold for 3 periods in our baseline estimation. We also experiment with shorter horizons and conclude that the results remain substantially unaffected.

2.3 Data

In the baseline specification of the empirical model the vector of endogenous variables y_t contains the variables: *government spending*, *output*, *household consumption*, *investment*, *total public debt* and *total external debt*, collected at annual frequency from 1980-2010.

For information on the data and sources see section (A) in the Appendix. All series are

⁶Matching the empirical results with the theoretical predictions in section (3) would necessitate additional restrictions on the responses of government consumption and public debt. Namely, we would need to impose that public debt increases one-for-one with government consumption. Forcing such a restriction however, results in no accepted draws, as public debt tends to increase disproportionately more than government consumption when no restrictions are used. We therefore calculate the distribution of multipliers and retain only those impulse responses that are consistent with multipliers being in the lower 5th-percentile of the distribution: we accept IRFs only if the multiplier on external debt for the Foreign shock and the multiplier on public debt for the Home shock is lower than the corresponding 5th-percentile cut-offs. This approximately corresponds to restricting the size of the multiplier on public debt to be less than 7.5, and the size of the multiplier on external debt to a Foreign-financed shock to be less than 15 which suggests that our estimates of absolute multipliers may be upwardly biased. However the relative difference between the two types of shocks remains unaffected. In case a restriction is not imposed qualitative results do not change, while multipliers tend to be higher in absolute terms (results available on request).

transformed in log differences and are set in per capita terms.⁷ Both types of debt are also in real terms. We employ 2 lags of the endogenous variables as proposed by the HQ criterion.

Following the literature on fiscal multipliers we calculate the cumulative multiplier as:

$$m_{t+s} = \frac{\sum_{q=t}^{t+s} \Delta \ln(X_q)}{\sum_{q=t}^{t+s} \Delta \ln(G_s)} \left(\frac{\bar{X}}{\bar{G}} \right) \quad (2.8)$$

where X corresponds to the endogenous variable of interest (output Y , consumption C and investment I) and G is government consumption. $\left(\frac{\bar{X}}{\bar{G}} \right)$ is the steady state of the endogenous variable over government consumption and serves to translate the growth rate into absolute values. We use the mean values of variables in our sample to calculate the steady states.⁸

2.4 Results

We estimate the SVAR using a Pooled Ordinary Least Squares Estimator.⁹

As can be seen from Figures (C.1) and (C.2) by distinguishing the government spending shock as Home debt-financed and Foreign debt-financed we obtain a differential response on the main variables of interest, investment. For a Home-debt financed government spending shock the responses is negative whilst for a Foreign-financed government spending shock it is positive. Government spending, private consumption, public debt and external debt increase by assumption for both shocks and output too increases in both cases, but at different magnitudes.

Moreover, from Figures (C.3) and (C.4) we can see that the magnitude of the output

⁷Outliers are identified as values differing from the mean of each time series by 6-times the interquartile range of their time series. Identified outliers are then replaced with the corresponding maximum value - in the case of a positive value, they are replaced by the mean plus 6-times the interquartile range, and in case of a negative value, they are replaced with the mean minus 6-times the interquartile range.

⁸Owyang et al. (2013) show that calculating multipliers in this ex post fashion may lead to upwardly biased estimates. They instead follow Hall (2009) and Barro and Redlick (2011) and convert GDP and government spending changes to the same units *before* the estimation. However, their framework is based on the Jorda decomposition and is thus not possible to use this transformation in a standard VAR specification, since here all variables must be of the same form. Nevertheless, even if the values we report further on are upwardly biased, the result we want to emphasize is the relative difference of multipliers between the two types of shocks, which remains unaffected.

⁹For details on the estimation algorithm see Section B in the Appendix.

multiplier is much smaller for a Home-financed government spending shock. The impact multipliers are approximately 1 for the Home-financed shock and approximately 3 for the Foreign-financed shock. The biggest difference is in the investment multiplier, which is negative for a Home-financed shock (-1.3), but positive and large for the Foreign-financed shock (3). Moreover, we find that in 99 percent of the accepted draws the investment multiplier is higher for a Foreign-financed shock. For output this is at 86 percent and for consumption at 80 percent of the cases.

It is worth comparing our estimates to Ilzetzi et al. (2013), a study, which is methodologically and in scope closely related to ours. Using a panel SVAR the authors estimate the dependence of fiscal multipliers on numerous country characteristics and find fiscal multipliers that range from being negative to well over 1 depending on the characteristic conditioned. Our results can be reconciled with these estimates as Ilzetzi et al. (2013) look at particular subsamples, which can potentially account for countries that finance their government spending using a mixture of both domestic and foreign debt. The higher data frequency used in their work is another plausible reason as to why our estimates of fiscal multipliers may differ.

2.5 Robustness Checks

By changing the assumptions, sample used, or the econometric strategy we are able to verify the robustness of our results. Notably, although in some cases our results are weakened, it is important to mention that at least some evidence is always present in favor of our baseline results and the economic intuition we obtain through the model. Thus, we are never able to generate the reverse result of home-financed government spending generating larger multipliers.

US data

In the case of the US we have available a full decomposition of the variables of interest - we have the exact data that comprise the following ratio: public domestic debt-to-public external debt. This allows us to test the validity of our identification strategy

by simply including this ratio in the system and checking if the response of the ratio is as expected, without restricting it a priori. We choose to include the ratio itself rather than public external debt and public domestic debt in order to economize on degrees of freedom. The expectation is that the ratio will decrease following a Home-debt financed government spending shock and increase following a Foreign-debt financed government spending shock. As can be seen in Figures (C.5) and (C.6) the ratio follows the anticipated pattern. This verifies our expectations and hence lends validity to our initial identification and estimation across the whole sample.

Alternative estimation procedures

Here, we proceed by relaxing one of the assumptions in our original shock identification, namely that output increases following a shock to government expenditures. In order to make the shocks mutually exclusive, we assume external debt increases after the business cycle shock. As can be seen from Figures (C.7) and (C.8) the results are similar to our baseline specification with the output multiplier being larger in the case of a Foreign-financed shock.

In Figures (C.9) and (C.10) we relax the assumption of constraining the size of the debt multiplier (see footnote 6). Whilst in Figures (C.11) and (C.12) we re-estimate our model using fixed effects in growth rates.

3 Model Environment

Consider a small open economy populated by a continuum of households $h \in [0, 1]$, of which a fraction s are rule-of-thumb workers (w) and the remaining fraction $1 - s$ are saver capitalists (k). Both types of households supply labor, and capitalists supply capital to perfectly competitive firms for the production of a final good, which is consumed domestically. Fiscal policy is determined by a government, which finances public spending via lump-sum taxes, one-period debt issued to resident saver capitalists, and one-period debt issued to non-resident foreign investors.

3.1 Preferences

Households are indexed by $j \in \{w, k\}$. In order to lighten the notation, we drop the index from the parameters although these can still be different across types of households. For each household j preferences are given by

$$U_t = E_0 \sum_{t=0}^{\infty} \beta^t \left\{ \frac{\left(C_t^j - \psi (n_t^j)^\varphi \right)^{1-\gamma} - 1}{1-\gamma} \right\} \quad (3.1)$$

where $E_t[\cdot]$ is the expectation operator conditional on information available at time t and β is the subjective discount factor assumed to satisfy $0 < \beta < 1$. $\psi > 0$ denotes the share of labor in the utility function and $\gamma > 0$ is the intertemporal elasticity of substitution. C_t^j is CES basket that aggregates over the private consumption good c_t^j and public consumption good G_t .

$$C_t^j = \left(\eta^{\frac{1}{\zeta}} (c_t^j)^{\frac{(\zeta-1)}{\zeta}} + (1-\eta)^{\frac{1}{\zeta}} (G_t)^{\frac{(\zeta-1)}{\zeta}} \right)^{\frac{\zeta}{(\zeta-1)}} \quad (3.2)$$

ζ governs the elasticity of substitution between the two types of consumption goods. For $\zeta \rightarrow \infty$ private and public goods are perfect substitutes, and for $\zeta \rightarrow 0$ they are perfect complements. η determines the shares of each consumption good in the basket.

Rule-of-thumb workers

Workers are assumed to behave in a rule-of-thumb fashion and in every period consume their disposable income earned from supplying labor. Expressed in terms of the private consumption good c_t^w they face the budget constraint

$$c_t^w = W_t n_t^w - \tau_t^w \quad (3.3)$$

where $W_t n_t^w$ is labor income and τ_t^w are lump-taxes (transfers if < 0). The representative worker on the interval $h \in [0, s]$ faces the simple optimization problem of choosing c_t^w and n_t^w to maximize (3.1) subject to (3.3) and (3.2) taking the price W_t as given.

Capitalists

Capitalists supply labor n_t^k and capital, and can borrow from the government as well as external financial markets. Their budget constraint in terms of the private consumption good c_t^k is given by

$$c_t^k + i_t + b_{h,t} - b_{f,t}^k = W_t n_t^k + r_t k_{t-1} + R_{h,t-1} b_{h,t-1} - R_{f,t-1}^k b_{f,t-1}^k - \tau_t^k \quad (3.4)$$

where i_t is investment in productive capital, $W_t n_t^k$ is labor income, $r_t k_{t-1}$ is the rent from capital, and $\tau_t^k > 0$ are lump-sum taxes. $b_{h,t}$ and $b_{f,t}^k$ denote the purchases of debt made at time t from the government and external financial markets. If $b_{h,t} > 0$ and $b_{f,t}^k < 0$ the capitalist is a borrower. $R_{h,t-1} b_{h,t-1}$ and $R_{f,t-1}^k b_{f,t-1}^k$ denote the gross returns from debt decisions made at time $t - 1$.

To ensure stationarity of private foreign debt and close the model accordingly we follow Schmitt-Grohe and Uribe (2003) and specify a debt-elastic interest rate of the form

$$R_{f,t}^k = \Psi(b_{f,t}^k) = r^* + \nu \left(\exp(b_{f,t}^k - \bar{b}_f^k) - 1 \right) \quad (3.5)$$

The interest rate faced by capitalists $R_{f,t}^k$ is a sum of the world interest rate r^* and a convex function of the deviation of individual debt $b_{f,t}^k$ from its steady state value \bar{b}_f^k . $\nu \geq 0$ determines the sensitivity of the interest rate to debt deviations and can be interpreted as the degree of external financial market openness for capitalists. If $\bar{\nu} = 0$ capitalists have perfect access and as such can issue debt abroad at the world interest rate $R_{f,t}^k = r^*$. As $\bar{\nu}$ increases the cost of external capital increases in an exponential fashion.¹⁰

The representative capitalist on the interval $h \in [1 - s, 1]$ chooses consumption c_t^k , labor supply n_t^k , as well as positions in government bonds $b_{h,t}$ and foreign bonds $b_{f,t}^k$ to maximize (3.1) subject to (3.4), (3.2) and (3.5) taking prices W_t , r_t , $R_{h,t}$ and $R_{f,t}^k$ as given.

¹⁰Notably, an alternative way to model the financial friction for capitalists would be to include portfolio adjustment costs.

3.2 Firms

On the production side output is produced using a Cobb-Douglas production function over capital k_t and total labor N_t .

$$F(k_{t-1}, N_t) = z_t k_{t-1}^\alpha N_t^{1-\alpha} \quad (3.6)$$

α determines the share of capital in production and z_t is an exogenous total factor productivity (TFP) shock that follows an AR(1) process with autocorrelation coefficient $\rho < 1$.

$$\ln(z_t) = \rho \ln(z_{t-1}) + \varepsilon_t \quad (3.7)$$

Firms choose k_{t-1} and N_t to maximize profits taking prices as given.

3.3 Fiscal Policy

Public spending G_t is financed with total lump-sum taxes $T_t = \tau_t^w + \tau_t^k$ and debt issued to domestic saver capitalists $b_{h,t}$ and foreign investors $b_{f,t}^g$. The government's budget constraint is given by

$$G_t - T_t = b_{h,t} - R_{h,t-1} b_{h,t-1} + b_{f,t}^g - R_{f,t-1}^g b_{f,t-1}^g \quad (3.8)$$

Public expenditures are determined according to an AR(1) process with drift $\kappa^g > 0$ and persistence ρ^g .

$$G_t = \kappa^g + \rho^g G_{t-1} + \varepsilon_t^g \quad (3.9)$$

To ensure determinacy of the equilibrium and non-explosive foreign government debt we follow Leeper (1991) and assume total taxes are set according to a debt targeting rule of the form

$$T_t = \kappa \left(\frac{B_{t-1}}{\bar{B}} \right)^\xi \quad (3.10)$$

where $B_t = b_{h,t} + b_{f,t}^g$, \bar{B} is the steady state value of total debt, and $\kappa, \xi \geq 0$. As in the private sector, foreign government debt is determined by the analogous debt-elastic

interest rate rule

$$R_{f,t}^g = \Psi(b_{f,t}^g) = r^* + \bar{\nu} (\exp(b_{f,t}^g - \bar{b}^g) - 1) \quad (3.11)$$

where $\bar{\nu} \geq 0$ measures the degree of openness of external financial markets from the perspective of the government. Possible reasons as to why external financial markets may not be perfectly accessible to the government include sovereign risk, a history of crises, political instability, among others. $\bar{\nu}$ is an important parameter as it also determines the government's debt portfolio. A value of $\bar{\nu} = 0$ would give that foreign borrowing is priced at the (world) risk-free interest rate $r^f = \frac{1}{\beta}$. The government's financing cost minimization problem ($\min R_{h,t-1}b_{h,t-1} + R_{f,t-1}^g b_{f,t-1}^g$ s.t. eq. (2.8)) would then imply the no-arbitrage solution $R^h = R_f^g = r^f$ and hence a positive share of both domestic and foreign debt. On the other hand, if $\bar{\nu} \rightarrow \infty$ it would become possible to generate a setting with exclusively domestic government borrowing. In practice however, even if $\bar{\nu}$ is large there will still be some negligible movement in domestic debt (savings) in order to finance foreign borrowing. As a result, changes in the value of $\bar{\nu}$ alone cannot generate a setting whereby government spending is financed with debt that is exclusively place at home or abroad.

To map our theoretical exercise with the results from the data, we introduce a parameter $\lambda \geq 0$ into the government budget constraint

$$G_t - T_t = \lambda (b_{h,t} - R_{h,t-1}b_{h,t-1}) + (1 - \lambda) (b_{f,t}^g - R_{f,t-1}^g b_{f,t-1}^g) \quad (3.12)$$

λ reflects the share of government debt that is issued *domestically*. When $\lambda = 1$ the government surplus is financed with debt issued domestically, whereas when $\lambda = 0$ it is financed with debt issued abroad. This allows us to perfectly capture the uncontaminated cases of a fully home-debt or foreign-debt financed spending shock. Importantly, for any $0 \leq \lambda \leq 1$ we still maintain the no-arbitrage condition $R_{f,t}^g = R_{h,t}$ as a solution to the government minimization problem.

3.4 Aggregation and Identities

Denote the aggregate quantity of a variable z_t by Z_t . Then,

$$Z_t = \int_0^1 z_t(h)dh = sz_t^w + (1-s)z_t^k \quad , \quad z \in \{c, n\}$$

Given that we assume that only capitalists have access to capital and asset markets, aggregate investment, capital and debt are given by

$$Z_t = \int_0^1 z_t(h)dh = (1-s)z_t^k \quad , \quad z \in \{i, k, b_h, b_f^k\}$$

Lump-sum transfers are assumed to be identical for both workers and capitalists

$$Z_t = \int_0^1 z_t(h)dh = z_t \quad , \quad z \in \{\tau_t\}$$

The current account CA_t is defined as the sum of the trade balance TB_t , and net investment income on the country's net foreign asset position.

$$TB_t = Y_t - C_t - I_t - G_t \tag{3.13}$$

$$CA_t = TB_t - R_{f,t-1}^g b_{f,t-1}^g - R_{f,t-1}^k b_{f,t-1}^k \tag{3.14}$$

Finally, the resource constraint of the economy is given by aggregating the budget constraints of households (3.4, (3.3) and that of the government (3.8).

$$C_t + I_t + G_t = F(K_{t-1}, N_t) + b_{f,t}^g - R_{f,t-1}^g b_{f,t-1}^g + b_{f,t}^k - R_{f,t-1}^k b_{f,t-1}^k \tag{3.15}$$

4 Quantitative Analysis

This section serves to illustrate the principal mechanism at work, and provide a robust theoretical explanation for the results we observe in the data in Section (2). As will be shown, the crucial feature that drives the differential effects of a government spending

shock are the extent to which private investment is crowded out or in. This is a direct consequence of whether the private sector has (im)perfect access to external financial markets at the time that the spending shock hits the economy.

We calibrate the model by setting the discount factor to 0.99 in order to achieve an interest rate of 1% at the baseline. Following conventional parameterization in the macroeconomic literature we set the coefficient of relative risk aversion (for both workers and capitalists) to 2, the share of capital in production to 0.33, the inverse of the Frisch elasticity of labor supply (for both workers and capitalists) to 1.5, the share of labor supply in the utility function (for both workers and capitalists) to 1, and the depreciation rate to 0.025 (see Mendoza (1991)).¹¹ Notably, we perform the following exercise by setting $\eta^w = \eta^k = 1$. That is, we do not allow for the consumption of the public good to enter the consumption baskets of neither workers nor capitalists. In this way we rule out the increase in private consumption that would follow a spending shock and as such insulate output to only respond to investment. We relax this further down to show how by generating a crowding-in of consumption we can bring the model's responses on output quantitatively closer to the magnitudes from our empirical investigation.

4.1 No Private Access to External Financial Markets

In what follows we assume that private access to external markets is completely restricted. Although in theory this is achieved when $\nu \rightarrow \infty$ we experiment with several values for ν and conclude that a value of $\nu = 50$ is enough to restrict all private foreign borrowing.

Figure (D.1) plots the impulse responses following a Home-debt financed ($\lambda = 1$) and Foreign-debt financed ($\lambda = 0$) government spending shock.¹² The key feature, which drives the differential changes in output across the two types of shocks is the movement in investment. When spending is financed at home investment is crowded out, whereas when it is financed abroad it is crowded in. The mechanism that brings about these

¹¹In sensitivity analyses (not reported here, but available upon request) we experiment with several other plausible values of parameters (for example s, η^j, ζ^j) and conclude that our results remain qualitatively unaffected.

¹²As each period in the model corresponds to one quarter we report mean responses across quarters to arrive at an annual aggregation. This is done to achieve a direct comparison with the empirical results, where the SVAR is estimated on annual data.

Table 2: Parameter Values for Household j

Parameter	Value	Label
β	0.99	Discount factor
r^*	$\frac{1}{\beta}$	World interest rate
α	0.33	Capital share
η^j	1	Share of consumption in CES consumption basket
ζ^j	2	Elasticity of substitution in CES consumption basket
φ^j	1.5	Inverse of Frisch elasticity of labor supply
s	0.5	Share of workers
δ	0.025	Depreciation rate
ρ	0.9	Output persistence
σ	0.01	Output standard deviation
γ^j	2	Intertemporal elasticity of substitution
ψ^j	1	Share of labor supply
ν	$[0, \infty)$	Debt-elastic interest rate coefficient (household)
κ^g	0.05	Government spending constant
ρ_g	0.9	Government spending autocorrelation coefficient
$\bar{\nu}$	$[0, \infty)$	Debt-elastic interest rate coefficient (government)
κ	0.5	Tax rate parameter
ξ	0.3	Tax rate exponent

results can be understood by inspecting the capitalists' budget constraint (4.1) and the resource constraint of the economy (4.2). Since ν is large and all private foreign borrowing is restricted, the only foreign element the resource constraint will contain are government bonds.

$$c_t^k + i_t + b_{h,t} = W_t n_t^k + r_t k_{t-1} + R_{h,t-1} b_{h,t-1} - \tau_t^k \quad (4.1)$$

$$C_t + I_t + G_t = F(K_{t-1}, N_t) + b_{f,t}^g - R_{f,t-1}^g b_{f,t-1}^g \quad (4.2)$$

Assume that labor is constant. If spending is Home-debt financed, then to meet the resource constraint capitalists will need to reduce their consumption and/or investment. Due to a motivation for consumption smoothing ($\gamma^k = 2$), investment will be adjusting the most. If spending is Foreign-debt financed however then foreign government debt will increase to buffer the shock. In this case we do not observe such a decline in investment.

However, labor does not remain constant because of the wealth effect that the debt-financed spending shock generates. Regardless of the source of debt financing a spending shock leads households to increase their labor supply in response to anticipated future

increases in taxation. The parameterization implies that the increase in labor supply is greater for the case of a Home-financed spending shock. Strictly speaking, a Foreign-debt financed spending should induce an additional wealth effect from the lost interest rate payments that households would otherwise receive, but in equilibrium the first effect dominates.¹³

Moreover, following a Foreign-debt financed spending shock the increase in investment raises the marginal product of labor, thus incentivizing households to further increase their labor supply in the second period. In addition, the fact that capital takes time to build causes output to jump further.¹⁴ Finally, we also observe a deterioration in the current account, which occurs for either spending shock. This result lends validity to the assumptions we impose in the empirical exercise of Section (2).

At this point we do not stress the quantitative effects of spending shocks, and their translation to implied fiscal multipliers. Although it is evident that for Foreign-debt financed spending the response of output is greater, we leave the quantitative exploration of multipliers to Section (5).

4.2 Private Access to External Financial Markets

The results presented above rely on the fact that capitalists did not have access to foreign financial markets. Here, we relax this condition and allow for full *private* access to external financing. We do this by setting $\nu = 0.0007$. Figure (D.2) plots the impulse responses following a Home-debt financed ($\lambda = 1$) and Foreign-debt financed ($\lambda = 0$) government spending shock. The main difference is that the response of investment increases for both types of spending shocks. Capitalists can now buffer the increase in spending by borrowing from abroad.

¹³A utility specification, which features lower wealth effects would lead to a larger difference in the responses to the two shocks. An extension of interest (not reported here) allows for a Jaimovich-Rebelo-type utility specification (Jaimovich and Rebelo, 2009), where the strength of wealth effects can be altered. We observed that weaker wealth effects led to a larger difference in the output responses to the two shocks.

¹⁴If we had not aggregated the responses at an annual frequency then the response of output following a Foreign-financed government spending shock would not necessarily be larger on impact. To circumvent this, we also experimented with a model for productive government investment (not reported here), which eliminates this possibility.

In order to reconcile the two polar cases of the private sector's access to external financing we experiment with the value of the private debt-elastic parameter within the range $0 \leq \nu < 0.03$. Figure (D.3) plots the responses of investment following a Home-debt financed ($\lambda = 1$) and Foreign-debt financed ($\lambda = 0$) spending shock for different values of the private sector's debt-elasticity parameter. As agents provide more labor in response to both shocks the marginal return to capital increases and agents are incentivized to invest. When the shock is financed abroad investment therefore always increases. On the other hand, for a domestically financed shock the response of investment depends on ν . When ν is low agents borrow externally to finance their investment and take advantage of the increased marginal return to capital. However, when ν is high external borrowing becomes prohibitively costly and investment falls as agents are obliged to spend a large share of their income to purchase government bonds.

5 Fiscal Multipliers

This section focuses on bridging the gap between the empirical investigation and the model-based analysis. We proceed by searching for combinations of model parameters that following a spending shock will replicate the magnitudes of the cumulative fiscal multipliers in the data. The intention is to evaluate whether the obtained parameter values are comparable to estimates in the literature. In this way we can establish whether plausible parameterizations of the model can explain the data quantitatively.

We categorize the set of parameters $\theta = (\theta_1, \theta_2)$, where θ_1 represents (deep) parameters, which we keep fixed to the same values as in Table (2). θ_2 are parameters, which we have identified to play a role in significantly altering the quantitative responses of the variables in the model, in particular that of private consumption. θ_2 includes the shares of the government consumption good in the aggregate consumption basket, η^w and η^k , the strength of complementarity between private and public consumption in the CES aggregator, ζ^w and ζ^k , and the share of rule-of-thumb workers s . We search for the θ_2 parameter values (see Table (3)), which will minimize the distance between impact multipliers from the model with those of the data. For certain combinations (namely

when η^j and/or s are above a certain threshold), a spending shock will generally lead to a crowding in of private consumption. Combined with the movements in investment (especially for a foreign debt financed shock) a spending shock under this parameterization will tend to produce greater impact multipliers. Thus making the results consistent with the relatively large multipliers we obtain in the data (3 with foreign financing, 1 for a home financing).

Table 3: Parameter values for matching impulse responses

θ_2		
η^w	{0.1, 0.3, 0.5, 0.7, 0.9}	Share of private consumption in CES (workers)
η^k	{0.1, 0.3, 0.5, 0.7, 0.9}	Share of private consumption in CES (capitalists)
ζ^w	{1.2, 1.4, 1.6, 1.8, 2}	El. subst. between private and public goods (workers)
ζ^k	{1.2, 1.4, 1.6, 1.8, 2}	El. subst. between private and public goods (capitalists)
s	{0.2, 0.4, 0.6, 0.8, 1}	Share of rule-of-thumb workers

By solving the model across all θ_2 parameter combinations we obtain 5^5 impulse response functions for each shock.¹⁵ Based on these we construct multipliers for each combination by following the definition used in the empirical investigation presented above. Consistent with Equation (2.8) the model-based multiplier is defined as

$$Multiplier = \frac{\Delta y_t}{\Delta g_t} \left(\frac{\bar{Y}}{\bar{G}} \right) \quad , \quad t = 0, \dots, T$$

and reads as the change in real GDP Δy_t caused by a 1% increase in government spending Δg_t , scaled by the ratio of steady state output to that of government spending $\left(\frac{\bar{Y}}{\bar{G}} \right)$. At time $t = 0$ we obtain the impact multiplier. Figures(E.1) and (E.2) plot the various responses of investment for the full set of parameter combinations. It is evident that for the vast majority of cases the response of investment is as expected, positive for a home-debt financed government shock and negative otherwise.

In order to make a formal comparison of output impact multipliers between model and data we minimize the sum of squared differences between the model- and data-generated output impact multipliers. To avoid indeterminacies, when simulating a home-

¹⁵We opt for a coarse grid rather than a continuous interval as certain parameterizations render the solution indeterminate.

debt financed spending shock we set $\bar{\nu} = 50$, whilst when simulating a foreign-debt financed spending shock we set $\bar{\nu} = 0$. We also let $\nu = 50$ as this case induces investment to respond in opposite directions following each spending shock. The latter will imply impact multipliers, which correspond to an upper bound.

Let $\gamma_j(\theta_2)$ denote the output multiplier to a debt-financed spending shock ε_j , where $j = h$ corresponds to a home-debt financed spending shock ($\lambda = 1$) and $j = f$ to a foreign-debt financed spending shock ($\lambda = 0$).¹⁶ In turn, $\hat{\gamma}_j$ denotes the estimated output multiplier generated by the SVAR.¹⁷ The minimum distance matrix is then defined as:

$$\Delta(\theta_2) = \arg \min_{\theta_2} \left((\gamma_h(\theta_2) - \hat{\gamma}_h)^2 + (\gamma_f(\theta_2) - \hat{\gamma}_f)^2 \right)^2 \quad (5.1)$$

Figure (E.3) plot cumulative multipliers for output, investment and consumption for the parameter combination that minimizes the distance matrix in (5.1). The impact multiplier on output is 2.47 for a Foreign-shock and 1.64 for a Home-shock. For the case of a Foreign-shock the model slightly undershoots the impact multiplier (3 in the data), whilst for the case of the Home-shock it slightly overshoots it (1 in the data). In similar fashion, the impact multiplier for investment for a Foreign-shock is 0.19 (3 in the data) and -1.1 for a Home-shock (-1.3 in the data), whilst is 0.84 for consumption (3.1 in the data) and 0.42 (0 in the data) respectively for a Foreign- and Home-shock. Notably, the parameter combinations, which achieve these results are $s = 0.4$, $\zeta^k = 1.4$, $\eta^k = 0.1$, $\zeta^w = 1.6$ and $\eta^w = 0.9$. We note that these values are by no means implausible or outliers to the literature.

5.1 Sensitivity Analysis

In order to better understand the effects from having $s = 0.4$, $\zeta^k = 1.4$, $\eta^k = 0.1$, $\zeta^w = 1.6$ and $\eta^w = 0.9$ we proceed by altering subsets of θ_2 , whilst keeping the remaining parameters

¹⁶Formally, the output multiplier should be denoted as $\gamma_j(\theta_2, \theta_1)$, as the model also contains θ_1 -type parameters. However, by setting θ_1 fixed we omit them from the notation.

¹⁷As we are interested in only matching theoretical to empirical output multipliers, we implicitly abstract from making assumptions regarding the horizon of the VAR representation of the structural model. The only assumption we make is that the structural model indeed admits a structural VAR, to the extent that its reduced-form representation provides us with multipliers that are informative for the structural model's parameters.

fixed either at the baseline calibration in table (2) or at the values minimizing (5.1).

Utility-enhancing government spending

η^k determines the weight of the public consumption good in the consumption basket for capitalists, whereas the parameter ζ^k governs the strength of the complementarity between capitalist consumption of the private consumption good and capitalist consumption of the public good. Figure (E.4) plots the difference in the output multiplier following the two types of government spending shock for different levels of these parameters. The left panel assumes no access to external financial markets by the private sector $\nu = 50$, whereas the right panel assumes a case of perfect access $\nu = 0$.

Share of rule-of-thumb households

Figure (E.5) plots output multipliers following the two types of government spending shock for different shares of rule-of-thumb worker households. The remaining parameters are fixed at their distance-minimizing values. Overall, we observe that Foreign-debt financed shocks lead to higher output multipliers across all simulations. However, increasing the share of rule-of-thumb households decreases both multipliers and even reduces them to 0 for extreme values ($s = 1$). This is because as capitalists are depleted from the aggregation, the more is productive investment displaced, leading to lower output responses. It turns out that this effect dominates the increased response of consumption due the high share of rule-of-thumb-workers.

6 Country Characteristics

It is evident that the key mechanism through which the theoretical results are obtained are due to crowding out of private investment and the extent to which the private sector has access to external financial markets. For this reason we return to the data. In the spirit Ilzetzi et al. (2013) we re-estimate the SVAR by conditioning on country characteristics that proxy for access to external financial markets. This will enable us to better reconcile the empirical results with those of the theoretical model.

We consider the following three measures of financial market openness: i) the share of loans from non-resident banks to GDP, ii) the number of crisis events, and iii) the variance of output. For the first measure we postulate that a country with a higher share of non-resident bank will have better access to foreign financial markets. Recent studies that make use of this measure, especially for cases of developing countries are Bandyopadhyay et al. (2012) among others. The other two measures are straightforward as it crises and real volatility are typically associated with risking risk premia.

Figure (F.1) reports the associated impact multipliers for output, consumption and investment following the two types of spending shocks. For all endogenous variables and across all measures, the results show that the difference in multipliers following each shock is smaller for countries with thinner access to external markets than for countries with thicker access. For example, for countries with a high variance of output, the impact multiplier on output following a Home-debt financed shock is 2.64, whereas following a Foreign-debt financed shock it is 5. For the countries with a low variance of output the respective impact multipliers are 0.81 and 5.60. As the relative difference in multipliers is smaller for the high output variance subsamples, we conclude that this verifies our theoretical predictions that a country's ability to borrow from abroad is a crucial feature in generating asymmetries. The share of accepted models where the output multiplier is larger for a Foreign shock over a Home shock is 71% for countries with high access and 97% for countries with low access.

7 Conclusion

In this paper we have asked the question: how do fiscal multipliers differ if a fiscal shock is financed with home debt, or foreign debt. To answer this question we have estimated an SVAR identified by placing conventional sign restrictions on the movement of endogenous variables and by complementing them with magnitude restrictions on the movement of government debt. For several specifications of the SVAR we find that fiscal multipliers are larger when government spending is financed by debt that is held in a foreign economy.

We validate our econometric methodology by building a model that can account for

these asymmetries. The fundamental mechanism that brings about this differential effect of government spending financing is the extent to which private investment is crowded out or in following the two types of government spending shocks. When the private sector can obtain access to foreign borrowing then investment tends to be crowded in for both types of government spending shock and output multipliers are qualitatively similar. When private access to foreign borrowing is completely restricted then the difference between the two shocks is most emphasized. The share of rule-of-thumb workers and the specification of households's preferences, in particular the extent to which government consumption can become utility enhancing, generate model-based multipliers that are consistent with those of the data. Policymakers dealing with the still-unfolding Eurozone crisis should take these asymmetries into consideration as advocating cuts in expenditures could result in deeper and miscalculated recessions.

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A Data and variables

Unless stated otherwise nominal values are converted to real values using the price deflator for private consumption expenditures. Data are in constant 2000 U.S. dollars.

Public Debt. The sum of total domestic and total external gross central government debt-to-GDP. Whenever central government debt is not available we replace it with general government debt. *Source:* Reinhart and Rogoff (2011)

External Debt. The sum of total public and total private gross external debt-to-GDP. *Source:* Reinhart and Rogoff (2011)

Output. Y_t is gross domestic product. *Source:* World Bank

Government Expenditures. G_t is general government final consumption expenditure. *Source:* World Bank

Consumption. C_t is final consumption expenditure. *Source:* World Bank

Investment. I_t is gross fixed capital formation. *Source:* World Bank

List of Countries in sample: Algeria, Argentina, Australia, Austria, Belgium, Brazil, Bulgaria, Canada, Chile, China, Colombia, Costa Rica, Denmark, Dominican Republic, Ecuador, Egypt, El Salvador, Finland, France, Germany, Ghana, Greece, Guatemala, Honduras, Hungary, Iceland, India, Indonesia, Ireland, Italy, Ivory Coast, Japan, Kenya, Korea, Malaysia, Mexico, Netherlands, New Zealand, Nicaragua, Norway, Panama, Paraguay, Philippines, Poland, Portugal, Romania, Russia, Singapore, Spain, Sri Lanka, Sweden, Switzerland, Thailand, Tunisia, United Kingdom, USA, Venezuela, Zambia.

B Estimation algorithm

The estimation procedure consists of three steps. In the first step, we estimate the reduced form VAR model. In the second step, we identify the structural shocks and in the third step we take into account estimation uncertainty. The steps are:

1. **Estimate reduced form VAR:** Given the number of lags proposed by Hannan-Quinn (HQ) or Bayesian Information criterion (BIC), \hat{p} , $VAR(\hat{p})$ is estimated by

Ordinary Least Squares (OLS) with fixed effects to obtain an estimate of autoregressive coefficients and the variance-covariance of reduced form errors, $\widehat{\Sigma}_u$.

2. **Identification restrictions:** non-structural impulse responses function, $C(L)$, is related to the structural impulse responses function as $B(L) = A_0^{-1}C(L)$ and reduced form errors, u_t , are related to structural errors as $u_t = A_0^{-1}B\varepsilon_t$. Impact matrix, $S = A_0^{-1}B$, must satisfy”

$$\Sigma_u = SS' \tag{B.1}$$

The estimate of impact matrix, \widehat{S} , is obtained by Cholesky decomposition of estimated variance-covariance of reduced form errors, $\widehat{S} = chol(\widehat{\Sigma}_u)$. We use non-uniqueness of the representation in (B.1) to derive the distribution of impulse response functions by sign restrictions:

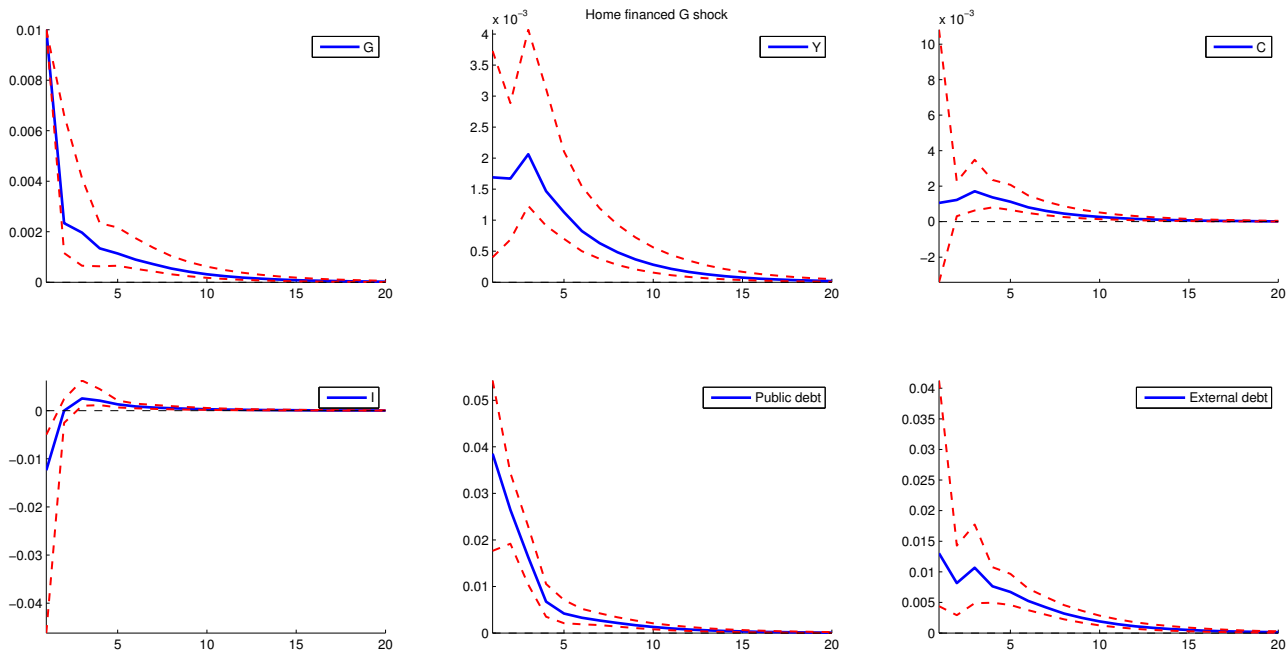
- First, the $k \times k$ matrix P is constructed with draws from a standard normal distribution, $\mathcal{N}(0, 1)$.
 - The QR decomposition of P is derived, such that $P = QR$ and $QQ' = I$.
 - The new impact matrix is constructed as $\widehat{D} = \widehat{S}Q$, and the corresponding impulse responses function is retained whenever it satisfies sign restrictions.
 - The steps 2-2 are repeated 1000 times. The IRF’s distribution is obtained by retaining the impulse responses functions that satisfy sign restrictions.
3. **Estimation uncertainty:** to account for estimation uncertainty, we repeat steps 1-2 1000 times, each time with a new artificially constructed data sample, Y^* . To construct data samples, we use block bootstrap, where blocks are individual countries. The countries are selected by random drawing with replacement from the pool of countries in original data set. The length of new data sample, n , is the same as length of original data set.

The IRF’s point estimates and the related confidence bands are constructed by retaining the median along with the relevant percentiles of the distribution of retained IRFs.

C Empirical Results

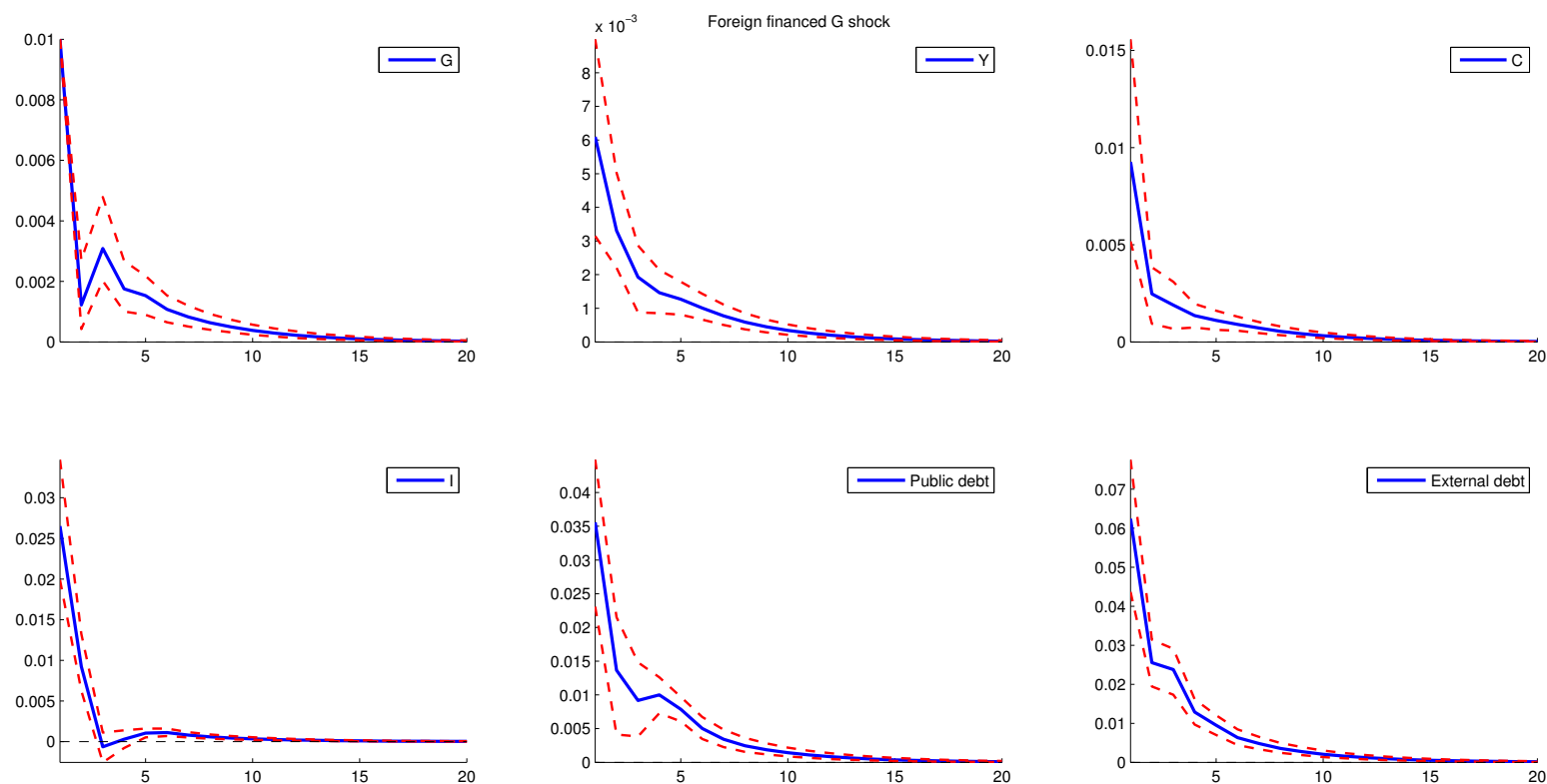
Baseline (section 2.4)

Figure C.1: IRFs to a government spending shock financed with home debt - baseline estimates



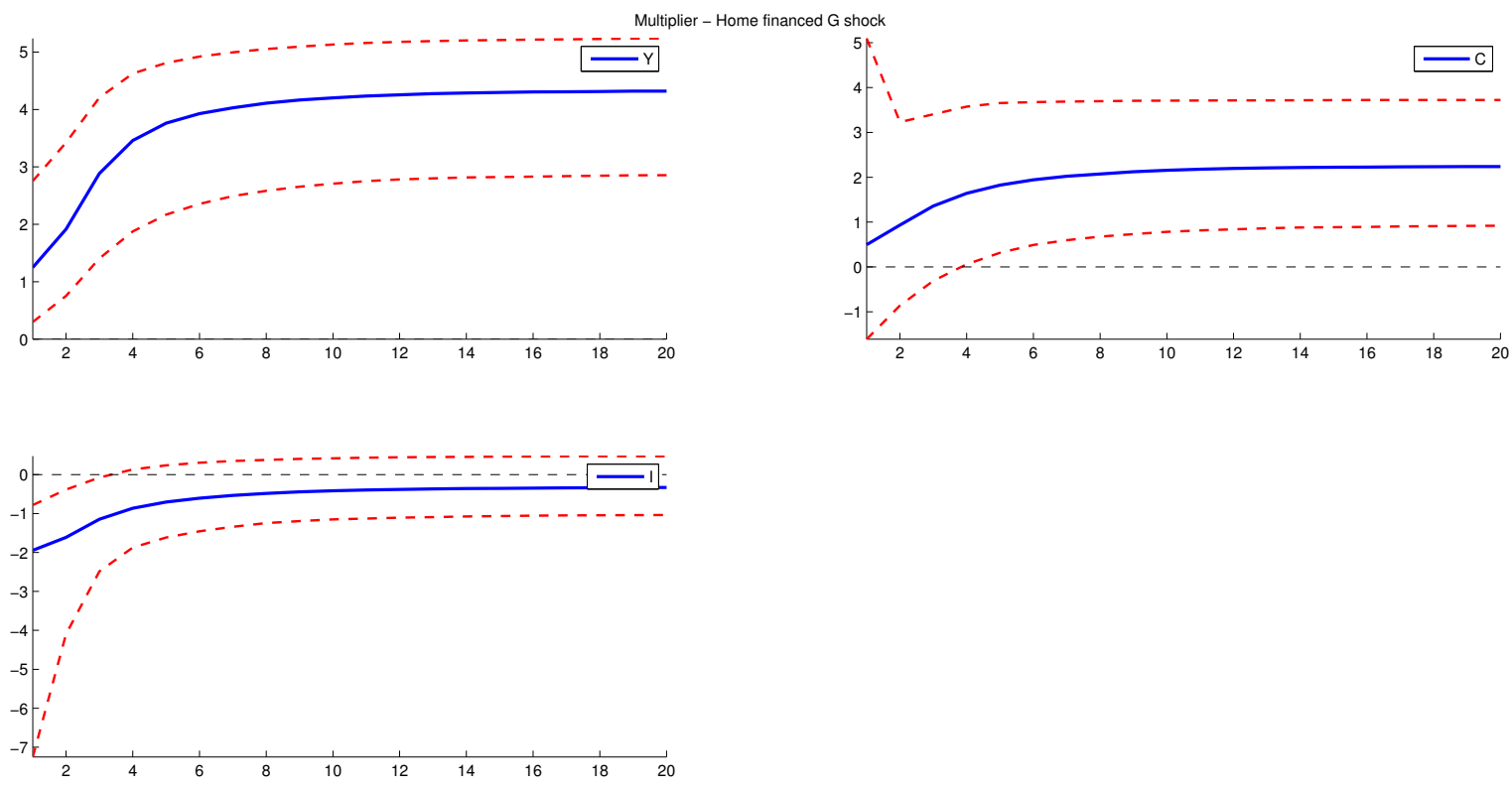
Notes: IRFs are presented for the baseline case with variables: government consumption, real output, real household final consumption, real investment, public debt and external debt. The dashed lines correspond to identification and parameter uncertainty of one-standard deviation.

Figure C.2: IRFs to a government spending shock financed with foreign debt - baseline estimates



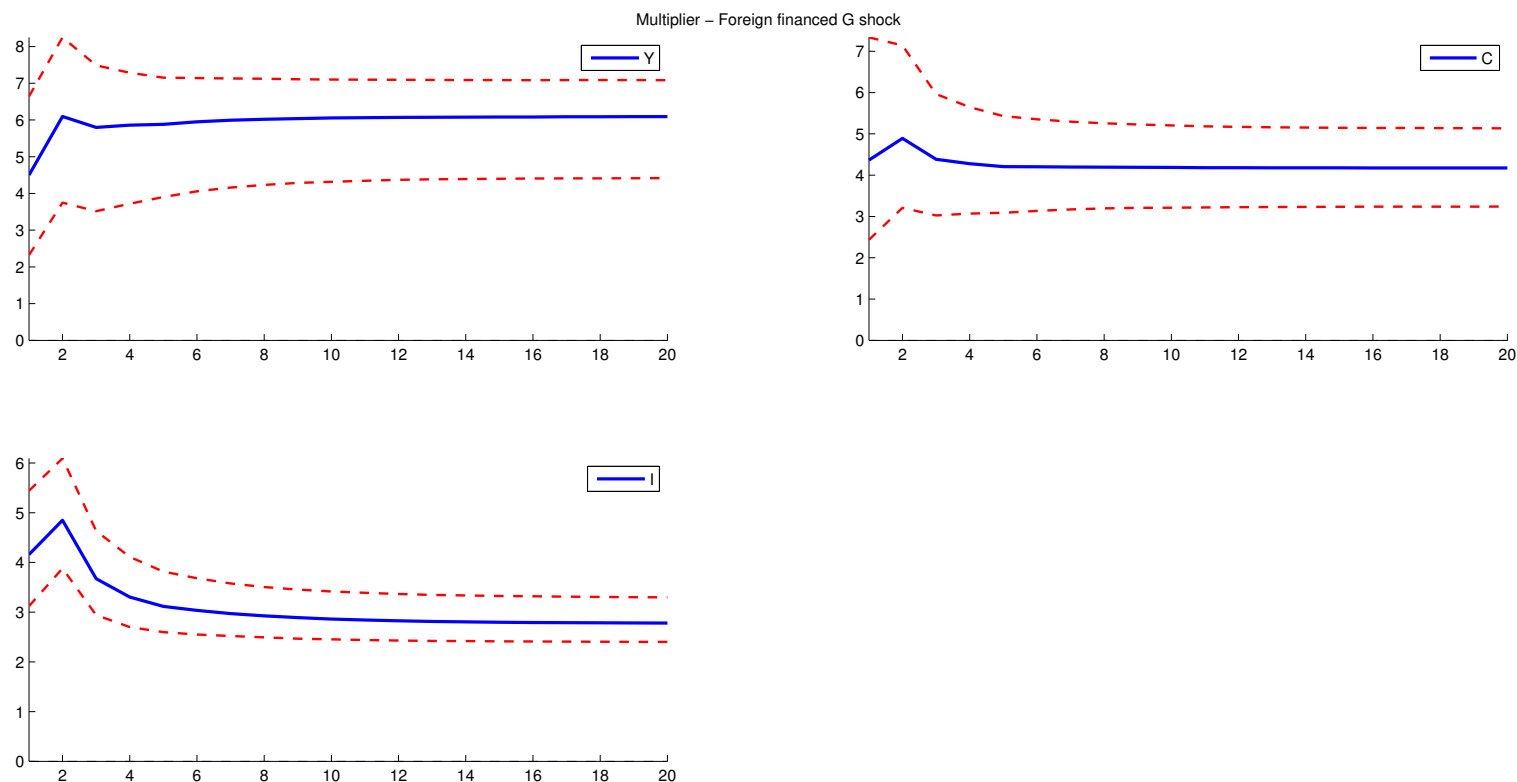
Notes: IRFs are presented for the baseline case with variables: government consumption, real output, real household final consumption, real investment, public debt and external debt. The dashed lines correspond to identification and parameter uncertainty of one-standard deviation.

Figure C.3: Cumulative multipliers to a government spending shock financed with home debt - baseline estimates



Notes: the cumulative multiplier is defined as the ratio between the accumulated response of the log difference of variable of interest over the log difference of government consumption. The figure presents the cumulative multiplier for output, consumption and investment.

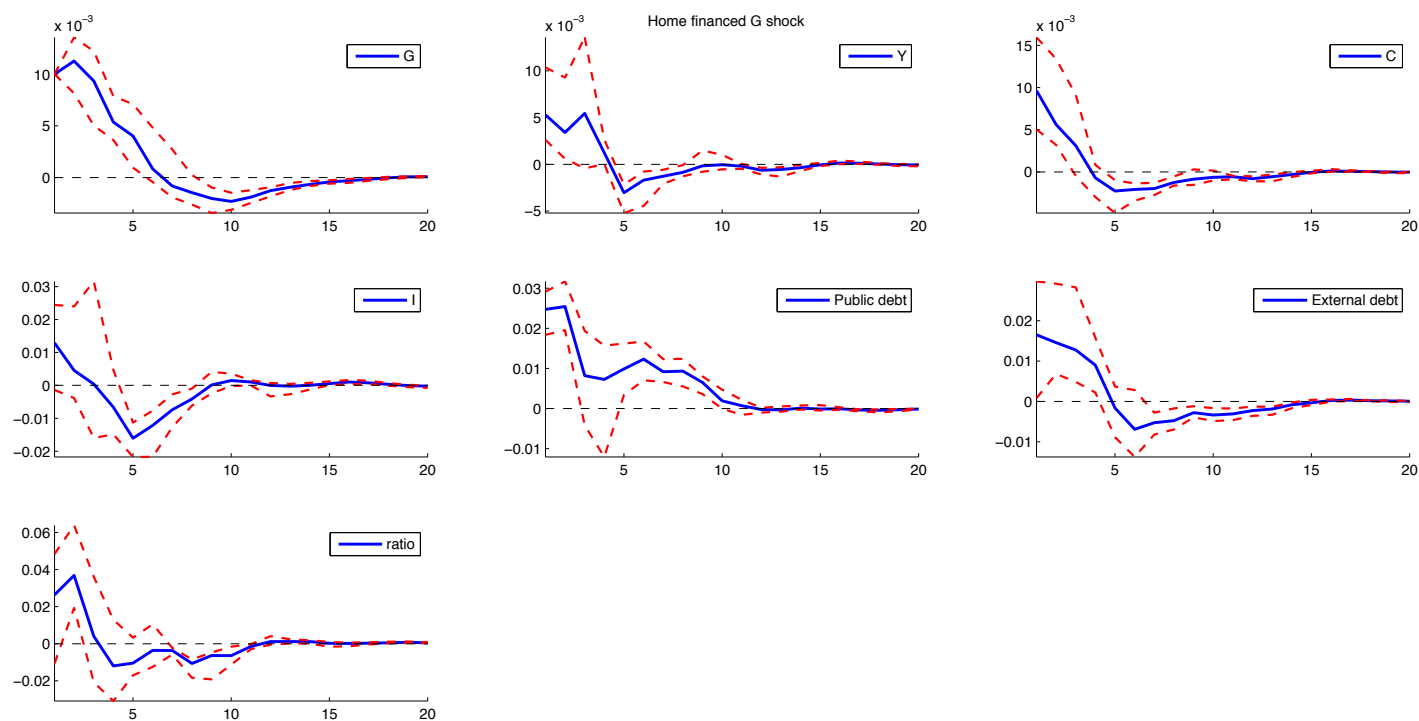
Figure C.4: Cumulative multipliers to a government spending shock financed with foreign debt - baseline estimates



Notes: the cumulative multiplier is defined as the ratio between the accumulated response of the log difference of variable of interest over the log difference of government consumption. The figure presents the cumulative multiplier for output, consumption and investment.

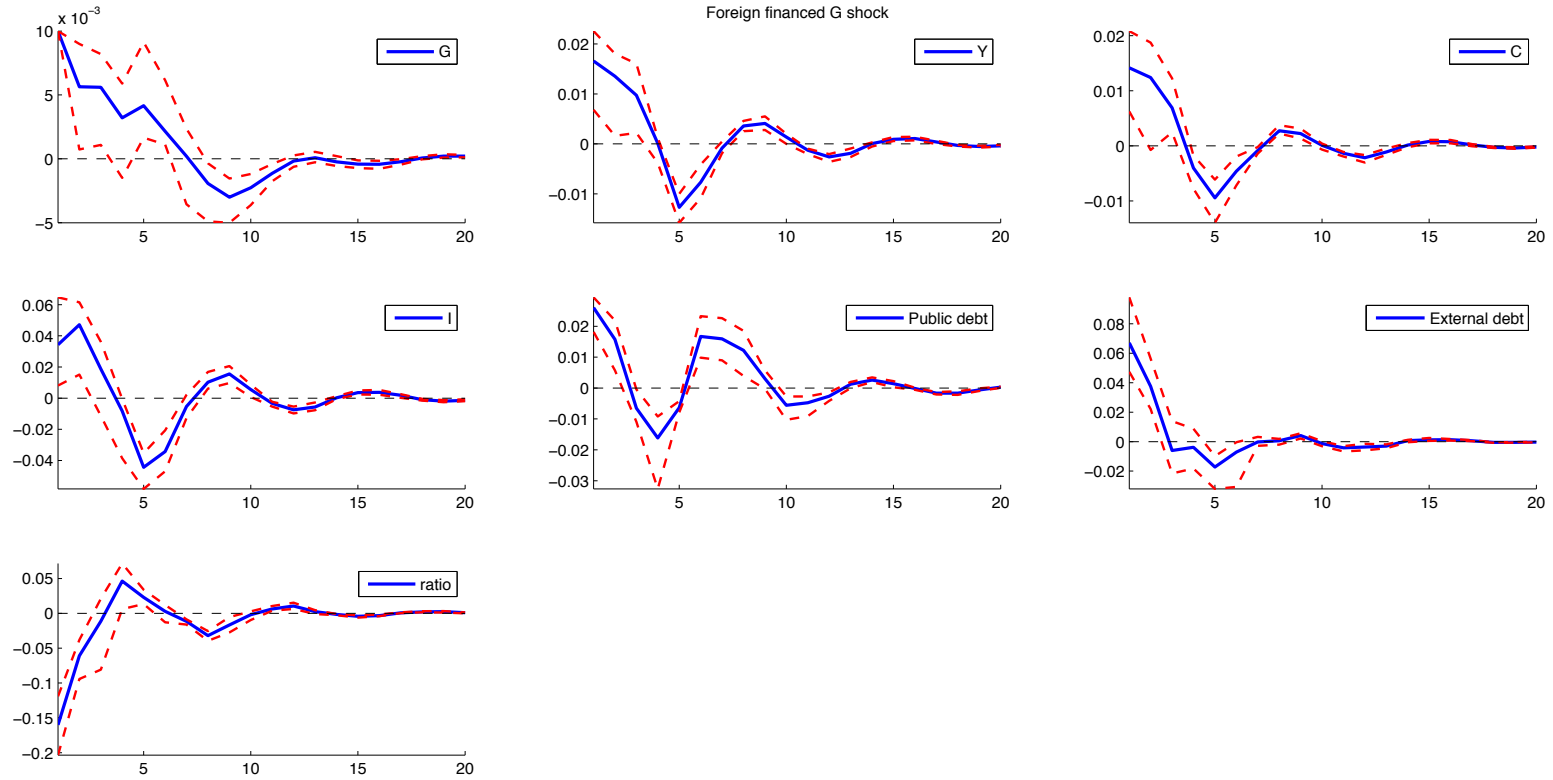
Robustness checks: US (section 2.5)

Figure C.5: IRFs to a government spending shock financed with home debt - US



Notes: IRFs are presented for the US with variables: government consumption, real output, real household final consumption, real investment, public debt and external debt. The dashed lines correspond to identification and parameter uncertainty of one-standard deviation.

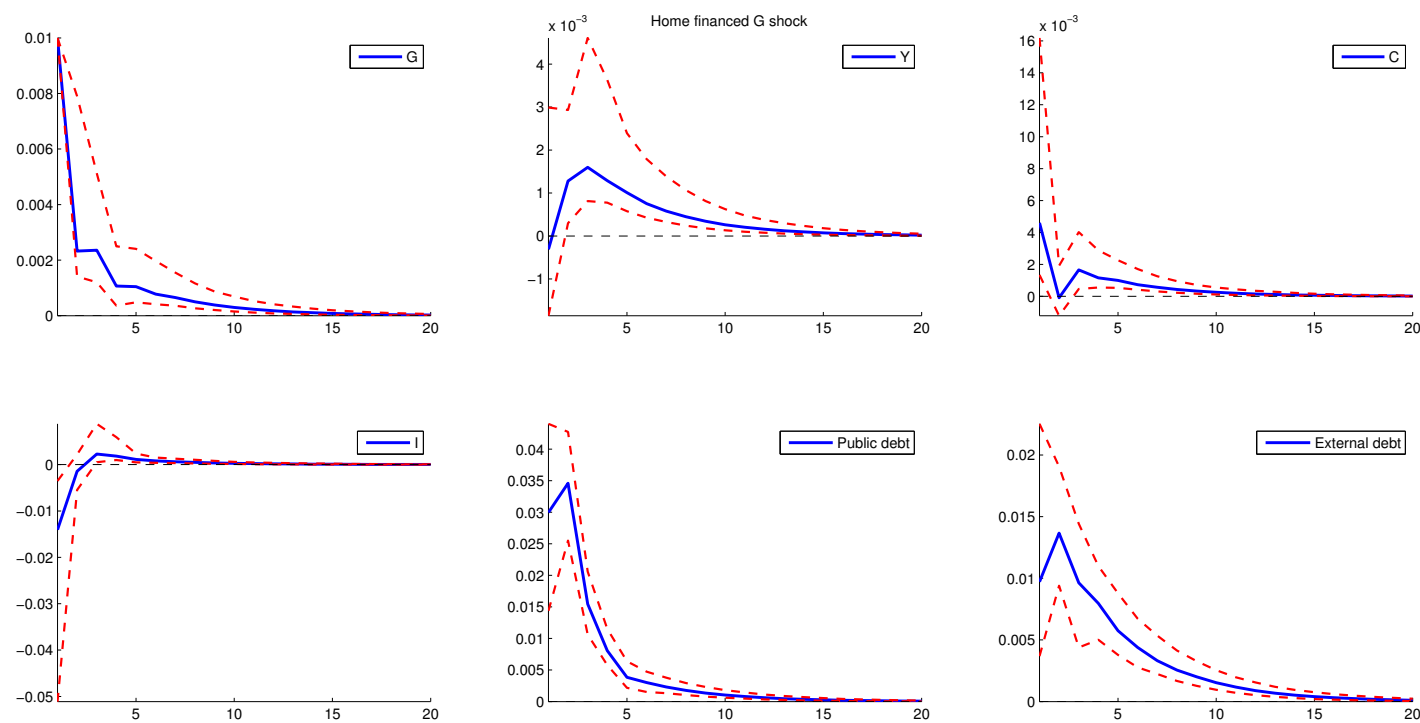
Figure C.6: IRFs to a government spending shock financed with foreign debt - US



Notes: IRFs are presented for the US with variables: government consumption, real output, real household final consumption, real investment, public debt and external debt. The dashed lines correspond to identification and parameter uncertainty of one-standard deviation.

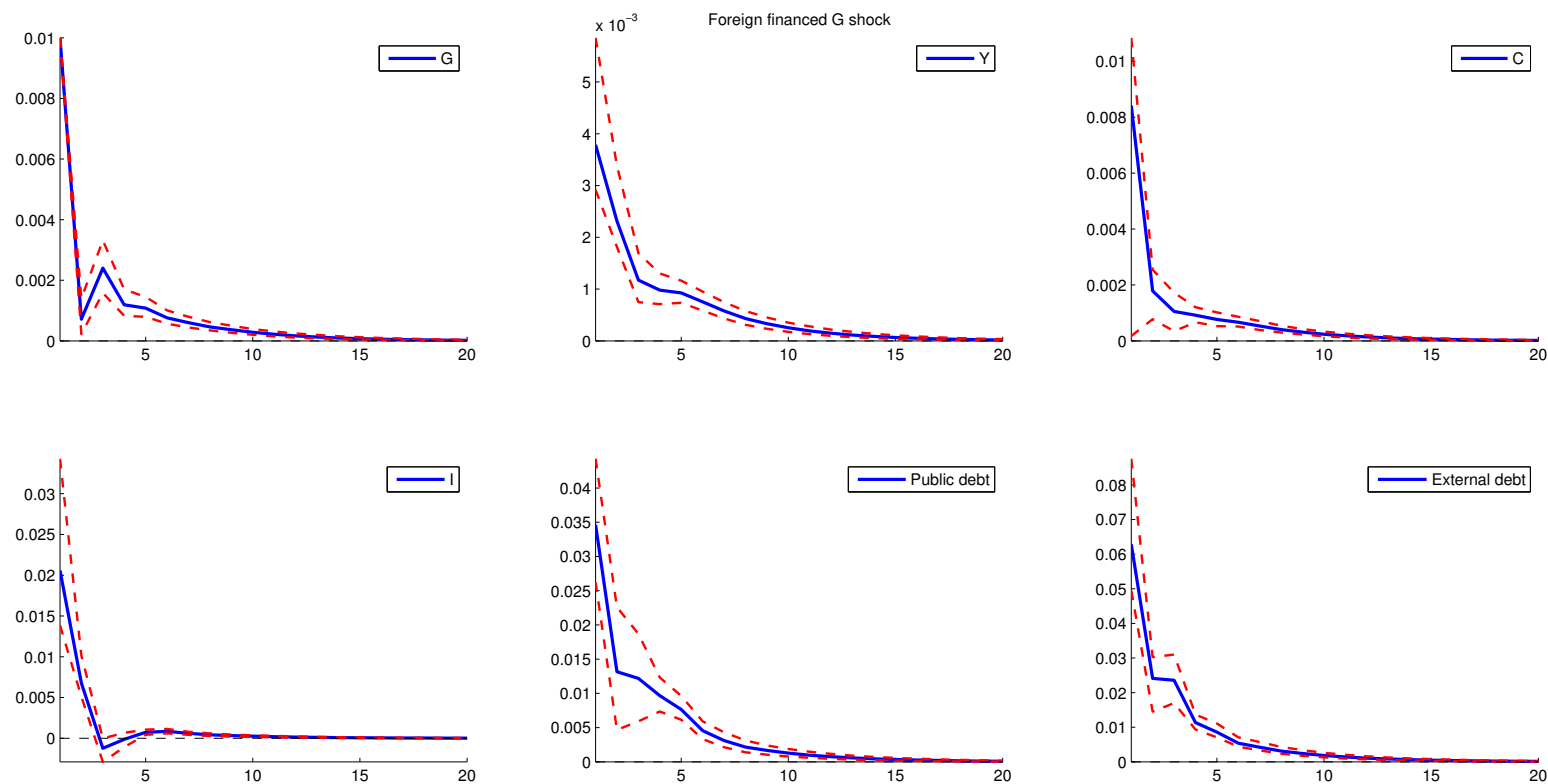
Robustness checks: no restrictions on output (section 2.5)

Figure C.7: IRFs to a government spending shock financed with home debt - output unrestricted



Notes: IRFs are presented for the variables: government consumption, real output, real household final consumption, real investment, public debt and external debt. The dashed lines correspond to identification and parameter uncertainty of one-standard deviation.

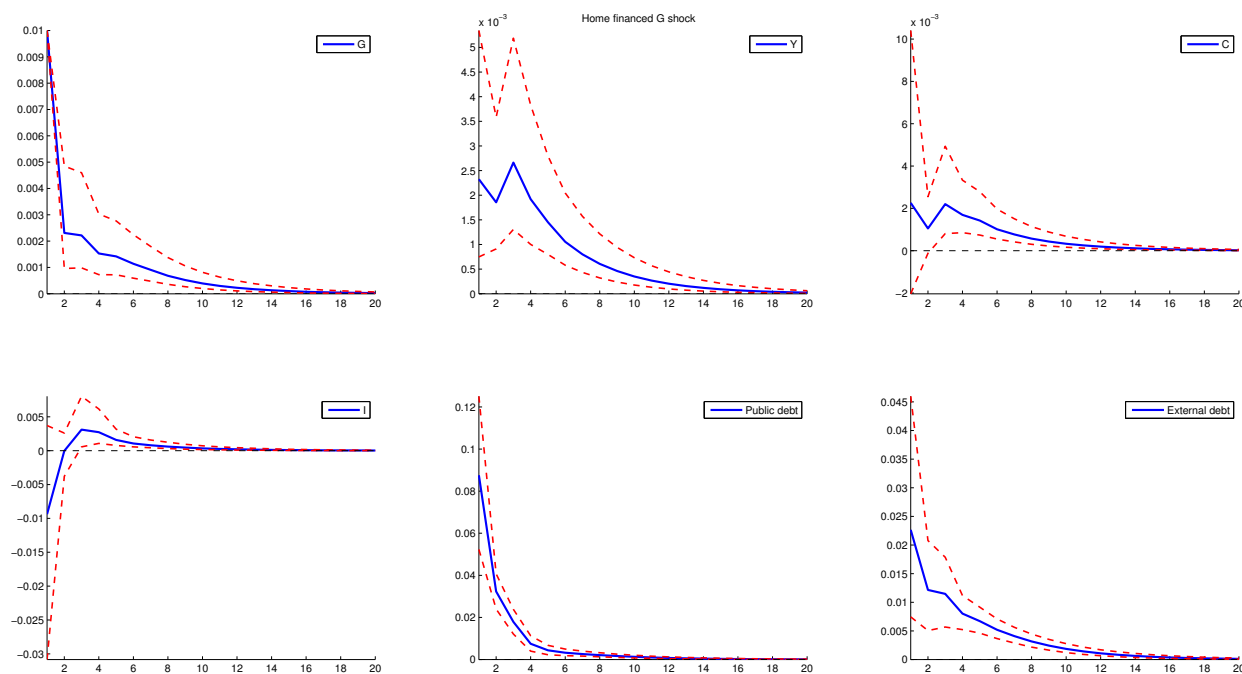
Figure C.8: IRFs to a government spending shock financed with foreign debt - output unrestricted.



Notes: IRFs are presented for the variables: government consumption, real output, real household final consumption, real investment, public debt and external debt. The dashed lines correspond to identification and parameter uncertainty of one-standard deviation.

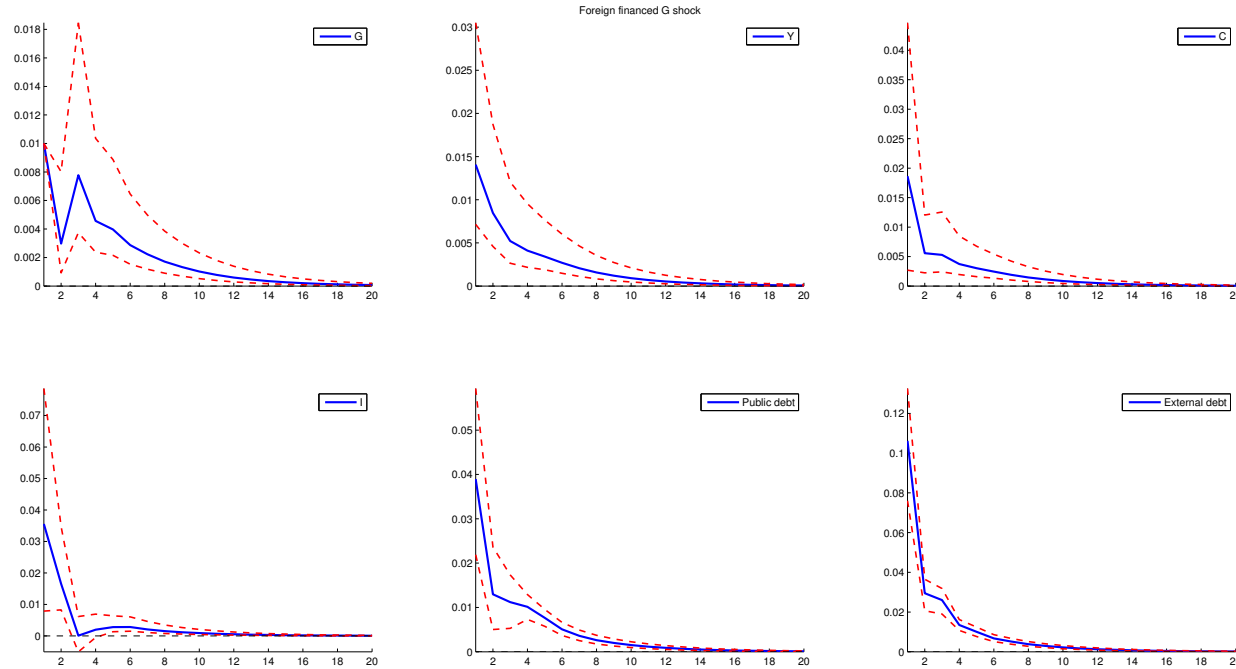
Robustness checks: no restrictions on debt multipliers (section 2.5)

Figure C.9: IRFs to a government spending shock financed with home debt - debt multipliers unrestricted



Notes: IRFs are presented for the variables: government consumption, real output, real household final consumption, real investment, public debt and external debt. The dashed lines correspond to identification and parameter uncertainty of one-standard deviation.

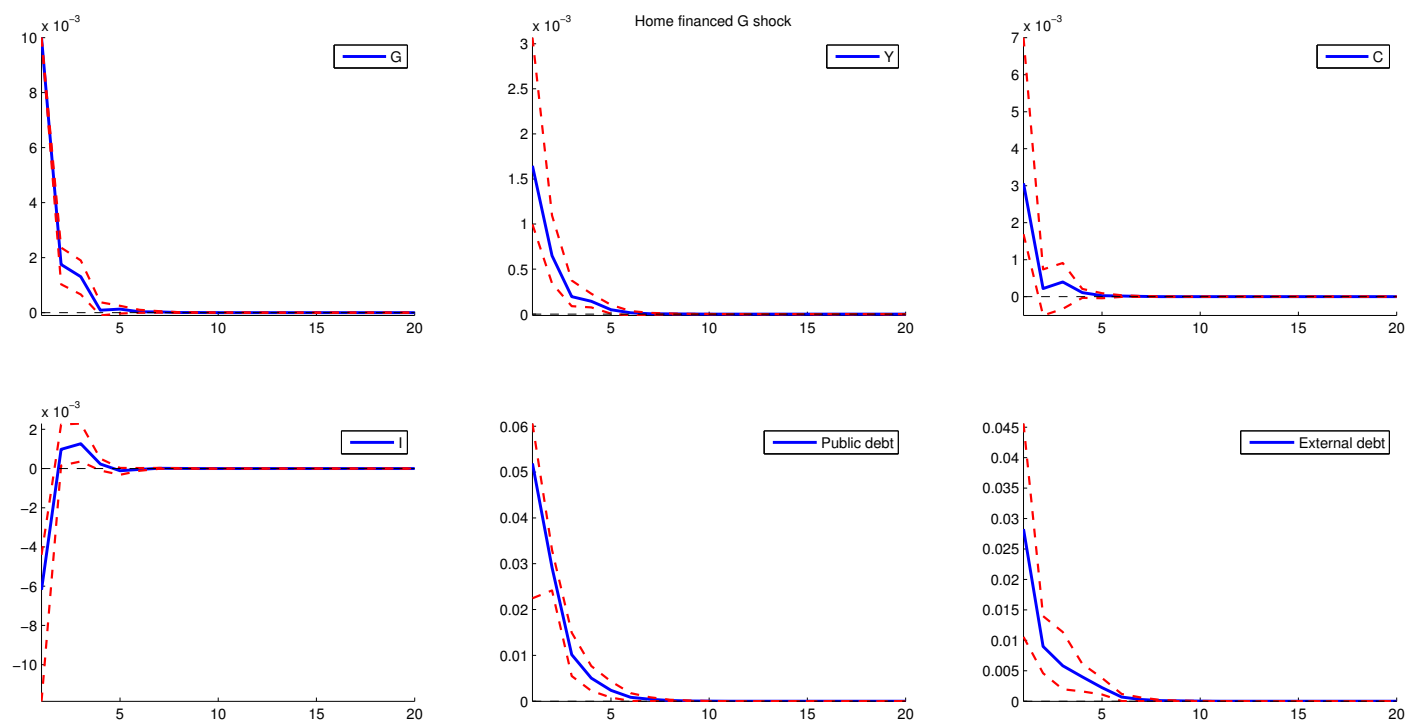
Figure C.10: IRFs to a government spending shock financed with foreign debt - debt multipliers unrestricted



Notes: IRFs are presented for the variables: government consumption, real output, real household final consumption, real investment, public debt and external debt. The dashed lines correspond to identification and parameter uncertainty of one-standard deviation.

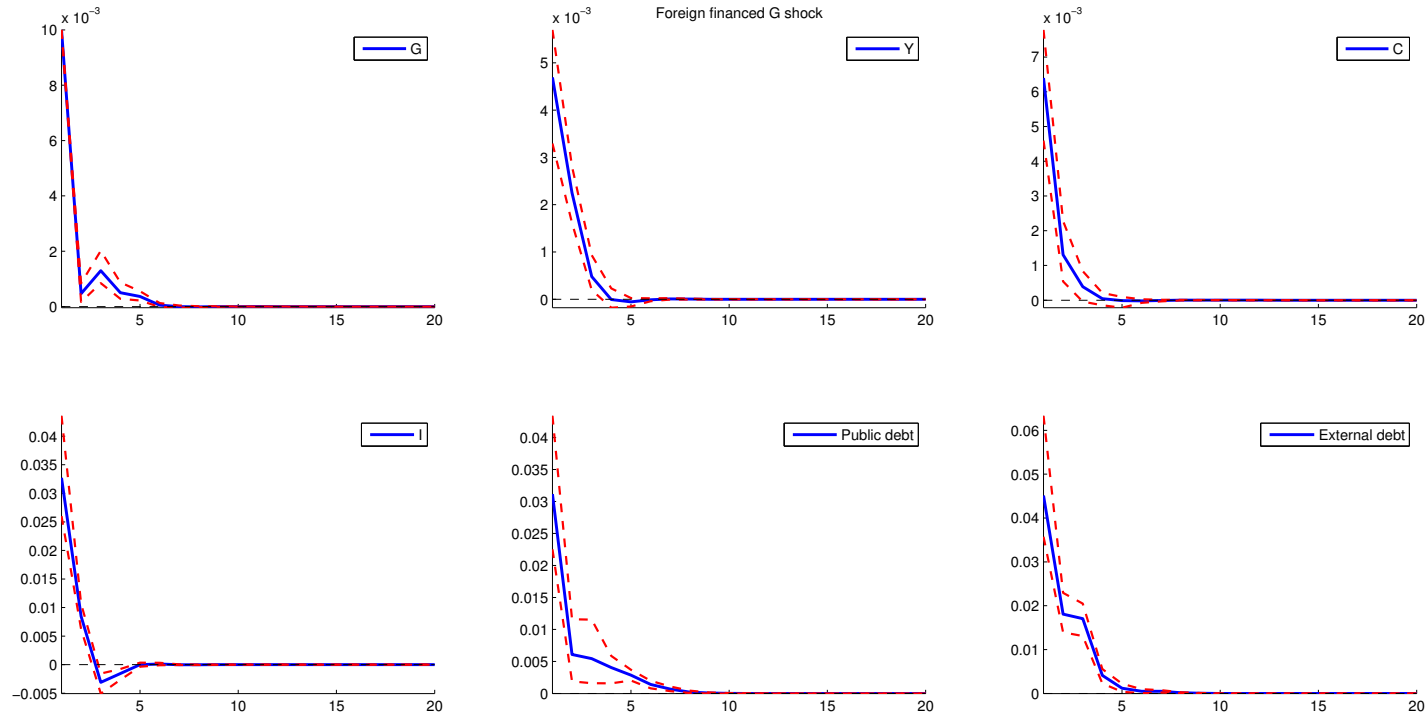
Robustness checks: estimation with fixed effects (section 2.5)

Figure C.11: IRFs to a government spending shock financed with home debt - fixed effects



Notes: IRFs are presented for the variables: government consumption, real output, real household final consumption, real investment, public debt and external debt. The dashed lines correspond to identification and parameter uncertainty of one-standard deviation.

Figure C.12: IRFs to a government spending shock financed with foreign debt - fixed effects

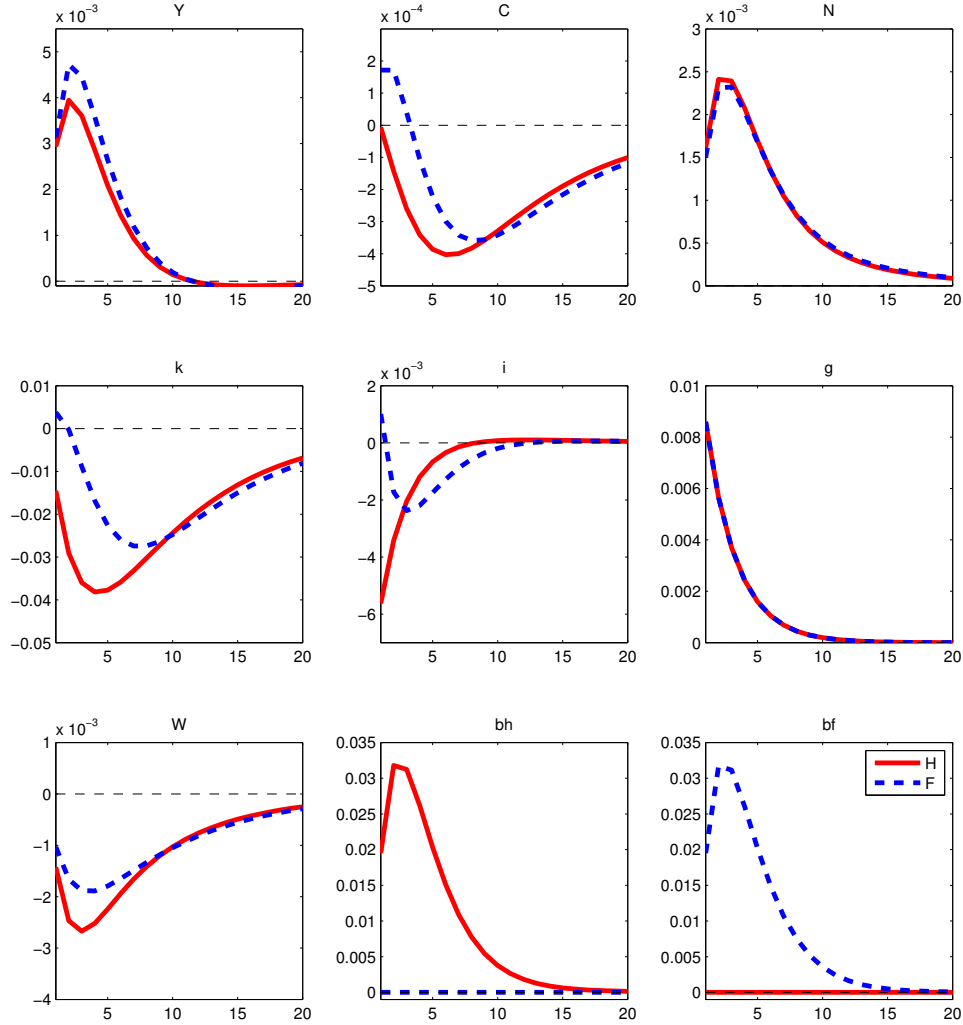


Notes: IRFs are presented for the variables: government consumption, real output, real household final consumption, real investment, public debt and external debt. The dashed lines correspond to identification and parameter uncertainty of one-standard deviation.

D Theoretical model

No private access to external financial markets (section 4.1)

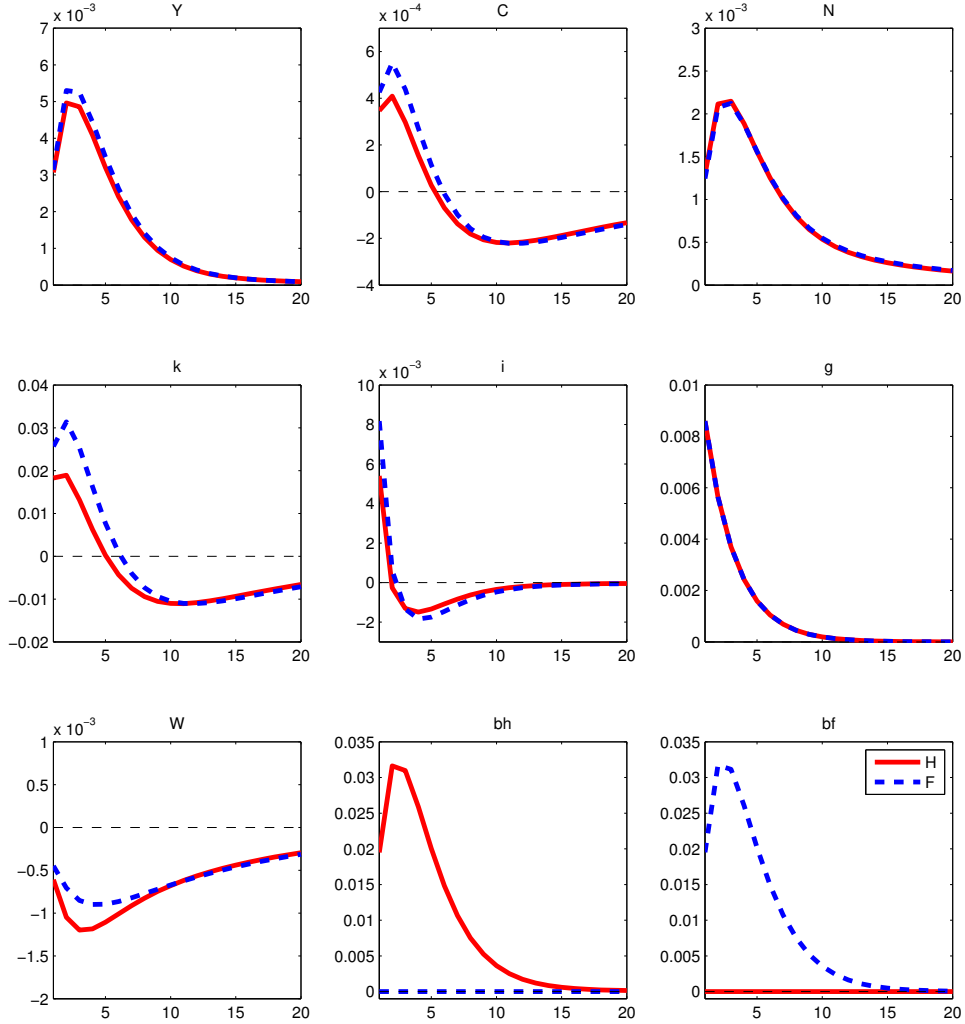
Figure D.1: IRFs following a home-debt financed and foreign-debt financed government spending shock



Notes: 100% home-financed shock, $\lambda = 1$ (dashed red line), 100% foreign-financed shock, $\lambda = 0$ (solid blue line). **No private access to external financial markets** ($\nu = 50$). Each period corresponds to one year.

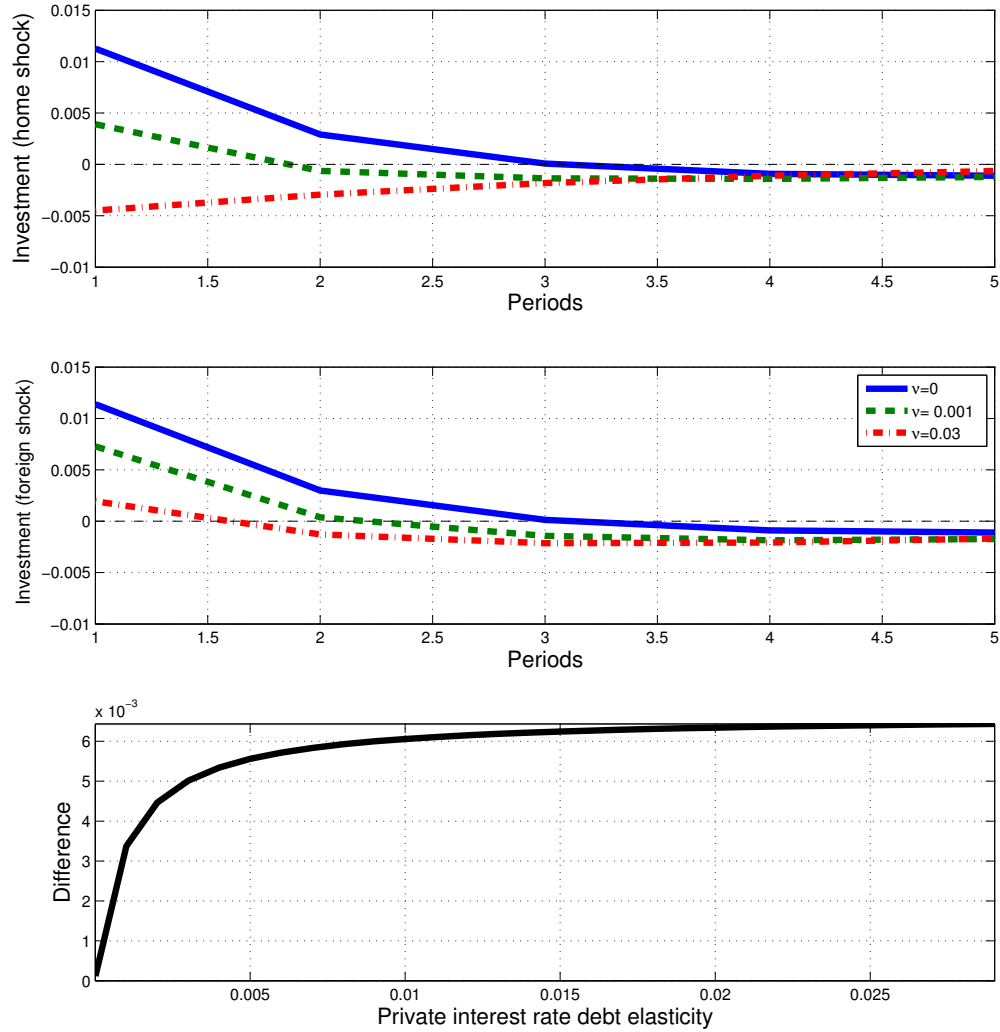
Private access to external financial markets(section 4.2)

Figure D.2: IRFs following a home-debt financed and foreign-debt financed government spending shock



Notes: 100% home-financed shock, $\lambda = 1$ (dashed red line), 100% foreign-financed shock, $\lambda = 0$ (solid blue line). **Perfect private access to external financial markets** ($\nu = 0.0007$). Each period corresponds to one year.

Figure D.3: Difference in the responses of investment following a home-debt financed and a foreign-debt financed shock to government spending



Notes: the top panel plots the difference in the responses of investment following a home-debt financed government spending shock, $\lambda = 1$. The middle panel plots the difference in the responses of investment following a foreign-debt financed government spending shock, $\lambda = 0$. For both cases the private interest rate debt-elasticity varies between $\nu = 0$ (blue solid line), $\nu = 0.001$ (green dashed line), $\nu = 0.03$ (red dashed line). The bottom panel denotes the differences in the two responses of investment for a range of the private interest rate debt-elasticity. Each period corresponds to one year.

E Fiscal Multipliers

Matching empirical multipliers (section 5)

Figure E.1: Investment multipliers to a government spending shock financed with home debt
 $\lambda = 1$ (annualized)

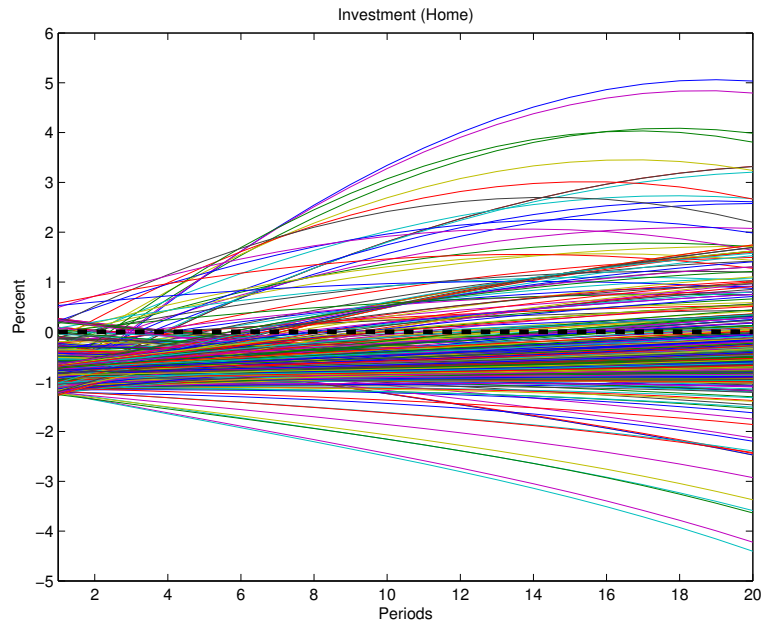


Figure E.2: Investment multipliers to a government spending shock financed with foreign debt
 $\lambda = 0$ (annualized)

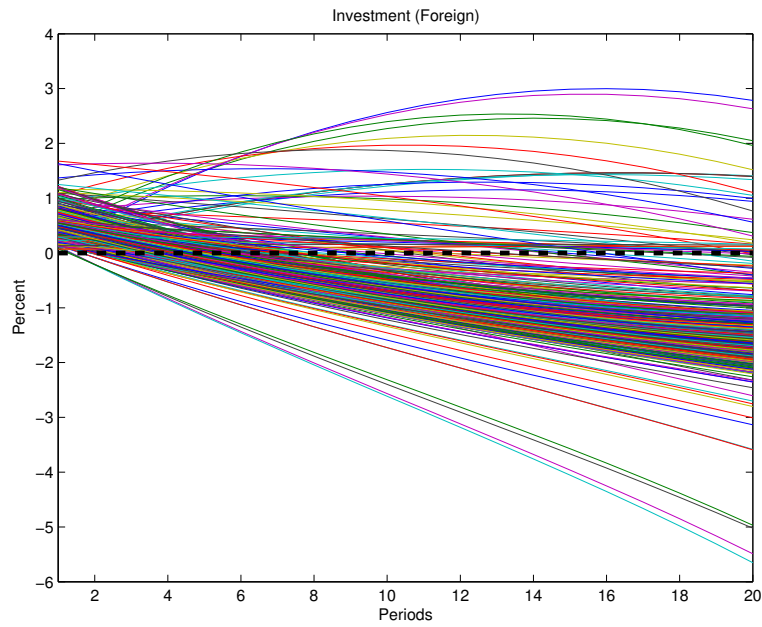
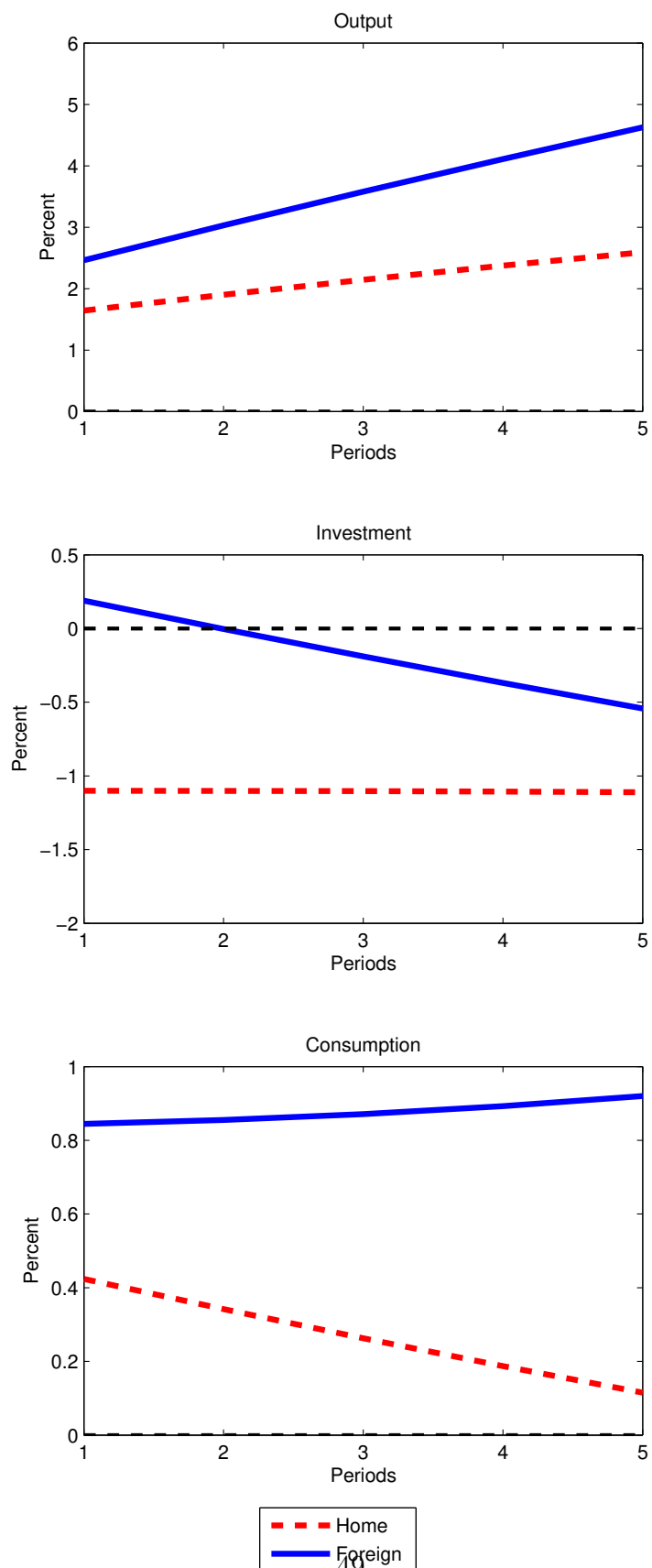
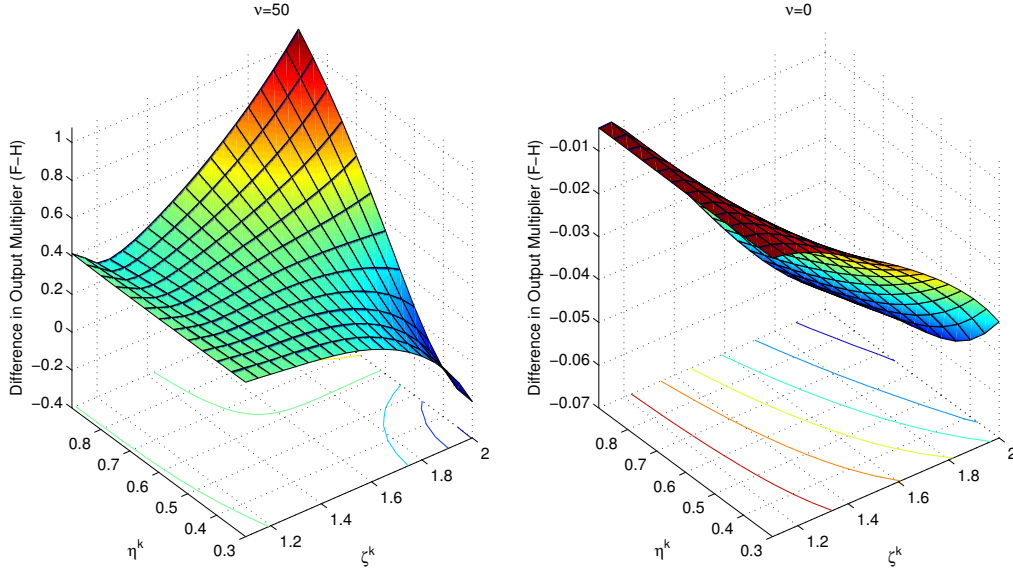


Figure E.3: Multipliers for output, consumption and investment to a spending shock financed with home $\lambda = 1$ or foreign debt $\lambda = 0$ (annualized). Parameters are set to: $s = 0.4$, $\zeta^k = 1.4$, $\eta^k = 0.1$, $\zeta^w = 1.6$, $\eta^w = 0.9$



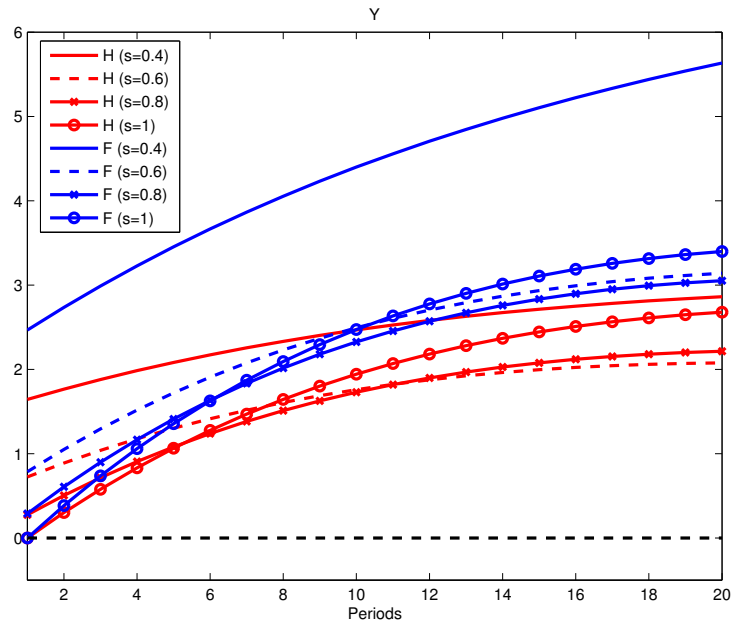
Sensitivity analysis (section 5.1)

Figure E.4: Difference in impact output multipliers to a government spending shock financed with home $\lambda = 1$ or foreign debt $\lambda = 0$



Left panel: no access $\bar{\nu} = 50$. Right panel: complete access $\bar{\nu} = 0$. Remaining parameters are set at baseline calibration (see table 2)

Figure E.5: Multipliers to a government spending shock financed with home $\lambda = 1$ or foreign debt $\lambda = 0$



Shares of rule-of-thumb consumers $s = \{0.4, 0.6, 0.8, 1\}$. Remaining parameters are fixed at $\bar{\nu} = 50$, $\zeta^k = 1.4$, $\eta^k = 0.1$, $\zeta^w = 1.6$, $\eta^w = 0.9$. Each period corresponds to one year.

F Country Characteristics (section 6)

Figure F.1: Impact Multipliers based on Different Country Characteristics - Access to Financial Markets Proxies

Variable	Access	Variance of output				Loans from non-resident banks to GDP				Number of crisis			
		<i>Home financed</i>		<i>Foreign financed</i>		<i>Home financed</i>		<i>Foreign financed</i>		<i>Home financed</i>		<i>Foreign financed</i>	
Output	High	2.64		5.00		0.92		3.70		2.17		2.34	
	Low												
Consumption	High												
	Low												
Investment	High												
	Low												

The Figure presents impact multipliers (in bold) for Y, C and I following a spending shock financed with home debt and foreign debt. Values to the left and right of the impact multiplier represent upper and lower bounds of one-standard deviation confidence intervals. High and Low Access differentiates the sample according to whether the country belongs above, or below the mean of the sample for each proxy (see section 6).